VOL. LXXXIX. No. 2299. [All Rights Reserved.] DECEMBER 16, 1921. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] PRICE SIXPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. 4. SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque.
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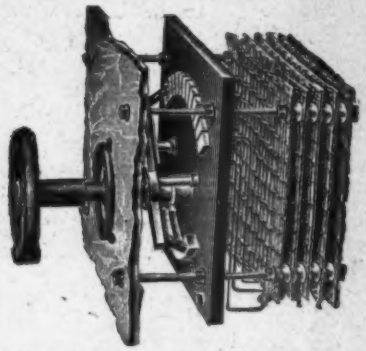

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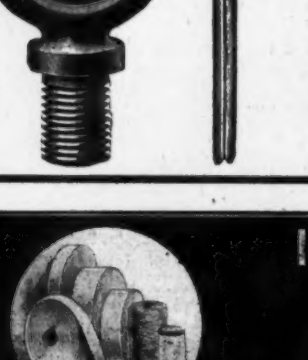

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ELECTRICAL REVIEW.

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GERMAN AMBITIONS.

IN offering the strongest possible opposition to the specious proposal that Germany should be allowed to carry out large super-power station equipment and railway electrification work in the British Isles, we believe we have spoken as the Voice of the Industry. Among those who have the real interests of British electrical industry at heart, the proposition has no friends. The eminent English industrialist who adopted the idea which seems so clearly to have originated in Germany and to have been designed to serve German ends, admitted that he was not an electrical engineer, that it was a *dangerous* suggestion to make, and that electrical interests would have something to say against it. It must seem to some almost ludicrous to imagine that such a proposition could be thought of seriously for a moment by anybody who wished to safeguard the interests of the industry for the future. Be that as it may, the menace has reared its head, and though it may disappear because it is seen to be opposed to the interests of the industrial life of the nation, the incident, if we dare use so small a word with regard to it, must not be lost upon us. We must as an industry present a solid and unbreakable front to any such attack if it be renewed in some other form.

We sympathise with the view of those who advocate the abandoning of the war spirit now that we are at Peace, but we know only too well with whom we are asked to be friends, and with whom we are advised to resume, and substantially to extend, our pre-war relations. Unfortunately, our late enemies are indisposed, or unable, shall we say, remembering the peculiar psychology of the race, to lay aside their ambitions to gain economic and industrial supremacy by means of organisation, "a strong sense of duty," moral power, moral will, and all that sort of stuff, and we can imagine the self-congratulatory spirit with which the great industrial and financial magnates of Germany regard the agreement to be entered into with France under which they shall pay hundreds of millions of pounds of the reparation *debt* in the form of rehabilitation and equipment work in the devastated areas of France. Vast areas which were ruthlessly raked with a veritable devil's rake are to be rehabilitated by the destroyer in such a way as to provide prosperity for German trusts, shareholders, and hundreds of thousands of workpeople. We recognise as readily as anybody that France is not so industrially strong as she might have been, and it may be to her advantage to be assisted back to life again even by her aforetime destructive foe. But, after all, the other Allies have a say with regard to such a matter, and it does seem sickening to contemplate a recovery of Germany's credit by allowing her to gain material advantage and prestige out of the repair of her misdeeds, and to enlarge and strength her industrial organisation by the work that she would be permitted to do.

But the matter does not end there. Assume that Germany is unable to secure the realisation of her super-power station ideas here; that is but part of her plan defeated. She looks to secure large business in France under the Loucheur-Rathenau agreement, but even that does not by any means satisfy her desires, and by moral power, will power, or whatsoever other influence we please to call it, she plans to secure the lion's share in the reconstruction of Russia. Now this is a prize worthy of a contest. There are other great manufacturing and concession-working nations besides Germany, and they will do well

to watch their interests, or Germany may realise her dreams of economic conquest and world industrialisation far more quickly than they may think possible. Germany, with her industrial magnates acting as her plenipotentiaries, will do well to recognise that Britain and America have vast manufacturing productive and constructive capacities. Press dispatches from France suggest that Herr Stinnes, in his plans for Russian reconstruction, has, in conjunction with Herr Rathenau, advanced, as the basis of negotiations recently begun in London, the idea that "Great Britain, the United States, and France" will form "*with Germany* a consortium for the economic reconstruction of Russia." We Allies are to find the money, transport, and raw materials for Germany, in order to ensure Germany a *monopoly* of the manufacture and supply to Russia of finished articles. Metallurgical industries *are to be prohibited in Russia in order to safeguard this German monopoly!* Russia's future as an industrial nation is to be sacrificed to the ambitions of Germany. Yet her requirements in such directions are bound to be vast beyond all possible present-day conceptions as years pass by.

The profits from the German undertakings in Russia are to be shared between the Powers forming the consortium in such a way as to ensure the payment of war reparations. Think of it all! Germany is to be loaned the money to develop her industries, and to prevent the development of those of other countries, in order that she may be able to pay the price of her misdeeds! Of course, there would be a moratorium in order that the plan could be put into execution "as a trial." And if it failed—what then? The Paris report that tells us all these interesting Stinnes-Rathenau things, winds up by pointing out that this is a German scheme—a remark that fairly takes our breath away. Who *would* have thought it? Then further and finally, "similar schemes have already been mooted by friends of Dr. Rathenau, notably by Herr Deutsch, a director of the Allgemeine Elektricitats Gesellschaft." Again, who would have thought *that?* Well, we frankly confess that we should, and that is really why we are referring to the subject here and now. Unless the whole British electrical industry is thoroughly wide-awake and energetic and possessed of a spirit of large enterprise, German interests may gain their ends in France and Russia too. It is not enough to hope for their electrical defeat in our own islands. The reconstruction of Russia, when it really begins, will be largely electrical, and there ought to be men in British electrical life ready to play their part and grasp the opportunities.

Britain's Greatest Market.

So serious and so widespread was the effect of the Great War upon the markets of the world that scarcely a country could be named with which British trade did not experience either a severe reverse or an almost complete stoppage. Many of the best of Britain's former customers were gradually transformed into creditor nations, whilst with some other countries interchange dwindled practically to vanishing point. Yet throughout that period of measureless difficulty to the trader, business with one market fluctuated but little with regard to values; in fact, the British Empire as a whole not only maintained its position in the market in question, but even increased its share from 53 to 57 per cent. That market was India. Some very striking figures may be quoted here: In 1913, the United Kingdom shipped to India over £70,000,000 worth of goods of home produce, of which no less than £67,000,000, *i.e.*, 96 per cent., represented manufactured articles. In the year 1917 the figures were £60,000,000 and £57,000,000 respectively; in 1919, £70,860,000 and £67,100,000. In 1913, 16 per cent., and in 1917, 13 per cent. of the exported manufactures of the United Kingdom were shipped to India.

Somewhat later figures have been published by the Government of India, according to which, in the twelve months ended in March, 1920, the value of India's imports of merchandise (exclusive of Government stores) from the United Kingdom amounted to £105,000,000. Truly, therefore, India would appear to be a promising market. For the foregoing reasons, exceptional interest attaches to the review by Mr. T. M. Ainscough (H.M. Senior Trade Commissioner at Calcutta) of the conditions and prospects of British Trade in India, which is summarised on another page. Having regard to the possibility of a protectionist policy being generally adopted in India, Mr. Ainscough's remarks on the advisability of opening branch factories may be studied with some advantage, even by those manufacturers whose plans have hitherto been frustrated.

The Imatra Falls and Russia.

It must be at least ten years since a great scheme was brought forward for the utilisation of the Imatra falls of the Vuoksen in connection with the proposed electrical transmission of power to Petrograd, and, among others, Belgian concerns were interested in the project. The control over the falls, however, now lies in the hands of the Finnish Government, which contemplates proceeding with the work of installation at some future date for the supply of light and power in Finland, including the working of the State railways. In this connection attention may be drawn to the fact that Swedish hydro-electric experts recently paid a visit to Finland for the purpose of inspecting the site of the projected hydro-electric works, the party including Mr. Ekwall, engineer and principal of the Hydro-Electric Administration in Sweden. Mr. Ekwall, in the course of an interview with a Stockholm newspaper, is reported to have stated that before the war the question of the use of the power of the Imatra was ripe, and a big scheme with this object in view was prepared by the Hydraulic Construction Bureau at Stockholm under the guidance of Prof. Richerts. Since then the Finns have worked out an alternative project, and Mr. Ekwall has been given the honorary commission to solve the problem. This concerns the utilisation of the enormous water powers of the Vuoksen, which, after the regulation of the Saimen, are expected to yield from 600,000 to 700,000 h.p., whereas the Swedish works at Trollhattan at present only furnish 100,000 h.p. Concerning the question as to the present attitude of Finland towards the transmission of power to Petrograd, which was chiefly the basis of the original scheme, Mr. Ekwall does not feel disposed to express any opinion as the matter is of a delicate nature, and is also partly of a political character. The present scheme aims at the utilisation of 150,000 h.p. in the first place, which would be consumed in Finland, although it is considered that it would be more economical to install plant for 300,000 h.p. at the beginning.

It has transpired from other sources that opinions are divided in Finland as to the participation of Russia in the matter of the utilisation of the Imatra falls. In some quarters this idea is entirely rejected, while in other circles it is pointed out that Finnish-Russian co-operation would be of advantage to Finland and would strengthen her position. It is considered to be quite certain that the Russian capital as well as the whole of the North-Western district is dependent to a high degree upon the power of the Vuoksen, and it is said that the Russian industries which have been developed in this district on the basis of cheap supplies of English coal are in great need of electric power, whilst no large sources of power other than those in Finland are available. It is, therefore, deemed to be only natural that the colossal sources of power of the Vuoksen are attractive also to the Russians.

THE MIDLAND ELECTRIC MANUFACTURING CO.'S WORKS.

The difference between "natural history" and "natural philosophy," Lord Kelvin used to say, is *measurement*. Until precise methods of measurement are devised and applied, an art remains an "art" and not a science. Scientific methods are essentially methods involving measurement. But measurement alone is not sufficient to constitute a science; the data obtained by measurement must be correctly interpreted. Thus it is necessary (1) to devise methods of measurement, and (2) to ascertain the meaning of the measurement, in order to place a subject on a scientific footing.

Doubtless every art is capable of being subjected to measurement, but many still remain in the stage of guess-work. This is largely true of the management

Fig. 1.—Sales Correspondence Office.

of manufacturing industries. Successful management necessitates the production and sale of goods at a lower inclusive cost than the price obtained for them. The latter is a known figure; the former is the resultant of very many factors—raw material, labour, works and establishment charges, and selling expenses. Unless all these factors are ascertained by measurement, the managers must necessarily arrive at their values by processes of estimating, not to say guess-work; and if the values are consequently known only approximately, accurate deductions from such data are quite impossible. But if each item that goes to make up the cost of the finished product can be definitely measured, the situation is completely changed; scientific method can be substituted for approximation and "rule of thumb," and correct inferences can be drawn from the ascertained data. If, moreover, the measurement is continuous, so that fresh data are available every month, week, or even day, a continuous watch can be maintained over the manufacturing processes, and the effect of every change in method of manufacture, every hitch in the routine, every variation in the quality of workmanship or material, can be identified and duly appraised.

This seems a high ideal at which to aim; but one should always have an ideal and strive to approach it. Granted that in many industries the conditions do not permit of the close detailed costing that is necessary for this purpose, the fact remains that other industries allow of it, particularly those in which large numbers of articles of a few standard types are manufactured on repetition lines. Our purpose in this article is to give a brief description of a factory in which the principles to which we have referred are carried out to the fullest possible extent with the most beneficial results. The factory is that of the Midland Electric Manufacturing Co., Ltd., of Birmingham, which we recently were privileged to visit; this company manufactures ironclad switchgear for pressures up to 500 volts and for currents from 10 to 200 amperes, and confines its operations strictly to a limited variety of standard groups—some 16 or 17 in number.

The business was founded in 1908, and in the early days it largely consisted in the manufacture of switchboards and distribution boards, in which a notable feature was the well-known "Kantark" fuse. The outbreak of war, however, led to concentration on ironclad switchgear, for which there was an immense demand, and in 1916 the premises were considerably extended; at the same time the manufacturing methods were radically changed, and the managing director, Mr. W. L. Barber, decided to adopt a comprehensive system of records and accurate costing—in a word, to apply scientific method to every branch of the business. An immense amount of time and labour was devoted to the organisation of the system, which was gradually developed and brought to completion in 1919.

Before dealing with this aspect of the business we shall give some particulars of the works, to which the accompanying illustrations relate. The company has secured the ownership of the whole of the block of which the works form a part between Barford Street and Rea Street, and plans have been prepared for successive extensions in accordance with perfectly definite aims, the buildings being laid out and positions allotted to the gangways and even the individual machines. But after a certain amount of progress had been made, bringing the area occupied up to 24,000 sq. ft. in 1920, the Rent Restriction Act came into force, and, by prohibiting the removal of the dwelling-houses which stood on the site, brought the extensions temporarily to a standstill. As it happened, the urgency of the need for extensions was relieved by the sudden collapse of trade towards the end of last year, and the existing accommodation suffices for the immediate needs of the business at present. The works are laid out on modern lines, a single storey with saw-tooth roofs, and the freehold site which the company has acquired for their development has a total area of 70,000 sq. ft. It is intended eventually to utilise the whole of this area.

The stores are situated in Rea Street, where all raw material is weighed and examined on delivery. The

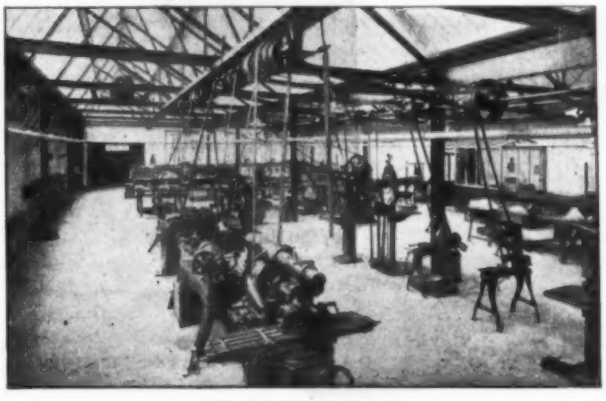


Fig. 2.—Tool Room.

principle adopted by the company is to purchase all components which can be made to better advantage in other works; such are iron and brass castings, screws, porcelains, and hot-pressed metal parts. Much use is made of extruded brass strip in special profiles to suit the requirements of the work, and brass castings are being replaced by this material and hot stampings.

As many of the cast switchboxes are of large size, and are delivered in large quantities, roomy iron bins and racks are provided for their storage. "Components" form the basis of the whole manufacture, and as over

3,000 different components are required for the company's standard products, a correspondingly ample provision of wooden shelving, &c., has been made. Components and finished products are handled in trucks on skids, moved about on trolleys, which can be brought under them and raised to lift the skids clear of the floor. The whole of the components are housed in the above-mentioned store.

Between the Rea Street stores and the dispatch department on Barford Street are the various workshops where the individual components are manufactured and the finished products are assembled.

Fig. 3.—View in Machine Shop.

Throughout the works (which are driven by electric power derived from the Corporation mains) the utmost use is made of templets and jigs, some of which are very elaborate, and a large tool shop is provided for their preparation and storage. Much use is made of special-purpose machines and labour-saving devices; for example, where brass parts are attached to porcelains, the screws are inserted and driven home in some cases by self-feeding machines, and in others by automatic hand screw-drivers. Enamelled parts are sprayed or dipped, and stacked on trucks, which are

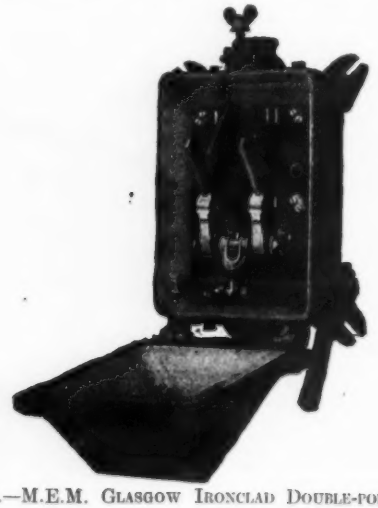


Fig. 4.—M.E.M. Glasgow Ironclad Double-pole Switch.

wheeled bodily into the gas-heated ovens. Many of the lighter parts are formed to shape by stamping and pressing, and numerous machines are provided for this purpose; capstan lathes, &c., are also freely used.

The works are heated with a system of hot-water piping, and are well lighted and ventilated.

Special consideration is given to the physical comfort of the workpeople and to their various methods of recreation in their leisure time; the arrangements for the latter are entrusted to the hands of committees, on which the supervisory staff is represented to provide a link with the management. Tea is provided daily for the whole of the employés at a nominal price, and facilities for warming and cooking food are placed at their disposal. Lectures, concerts, &c., are periodically arranged, and are well attended. So successful have been the endeavours of the management to develop and maintain harmonious relations with the employés, that "labour troubles" are practically unknown in these works.

The accompanying illustrations show some of the most typical products of the company. Throughout the range of its manufactures the Admiralty practice

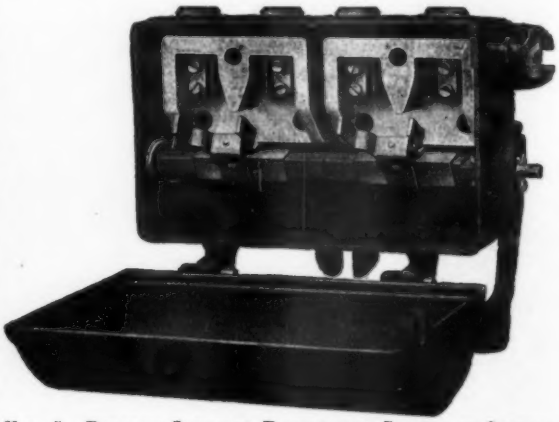


Fig. 5.—Paragon Ironclad Double-pole Switch of Lighter Type for Factory Use.

is followed of insulating with mica and porcelain, the switch parts being mounted on steel rods or bars with mica insulation; special attention is given to ease of assembling and facility of access, the requirements of the installer being kept in view. The fuseboard shown in fig. 6 can be easily disassembled in 10 seconds. In that shown in fig. 7, each of the fuse banks can be pulled forward and turned over for wiring, or entirely removed after withdrawing two screws. With each fuseboard a record of the correct fuse-wires is enclosed. Simplicity of construction is a marked feature of the designs; for example, a small cut-out box consists of two castings, which are self-

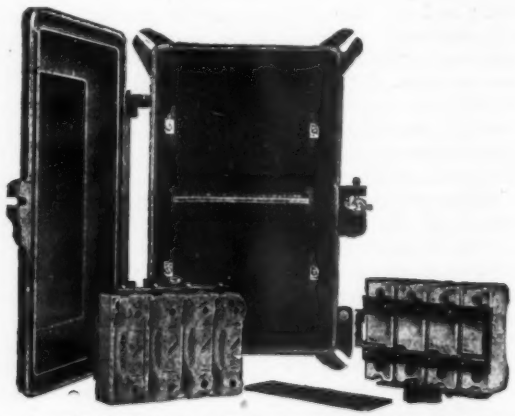


Fig. 6.—M.E.M. Ironclad Double-pole Fuseboard, 30-ampere Ways, Disassembled.

hinging and self-locking, so that no machining is required, and when it has been enamelled it is complete.

New designs are considered by a committee of heads of departments, and are thoroughly tried out before manufacture is resolved upon. In the drawing-office highly systematic methods are adopted; every component is drawn on a separate sheet of standard size, the tracing of which is filed conveniently for reference, blue prints being used in the shops. When a design has been adopted, the mechanism is mechanically tested exhaustively, a switch, for instance, being closed and

opened as many as 500,000 times. The method of production of each part is then settled, time studies being carried out and a standard working time arrived at, to which are added allowances for incidental operations and for rest, and these times, when once determined, are never changed unless the method of production or the design is changed. A premium bonus system is in force, under which the workman is credited with half the time saved on the standard time allowance; this system has proved very satisfactory to both parties.

In addition to the committee on design, there are periodical meetings of the heads of the staff to discuss matters which arise, and sub-committees to which specific questions are referred for investigation, a procedure which has proved most helpful.

Turning now to the system of records adopted in the works, we must say at once that a complete account of it would occupy far more space than we could devote to the subject; we have never met with an equally elaborated system in practical operation, or indeed anything approaching it, and in order to acquire an intimate knowledge of its working many days would have to be spent in studying the details of the system. We shall therefore confine our attention to an outline of the scheme. The criticism that it is unduly elaborate is met by the reply that it has efficiently fulfilled its purpose, and has materially reduced the cost of production. Within the last two years so marked an improvement has taken place that

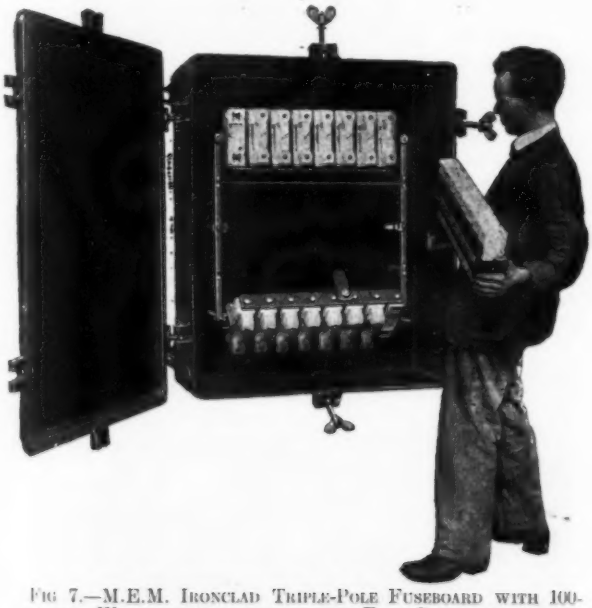


Fig 7.—M.E.M. Ironclad Triple-Pole Fuseboard with 100-ampere Ways, showing one of the Fuse Banks pulled out on the Telescopic Carrier and swung over for Access and Wiring. The Simplicity of Entire Removal of the Fuse Banks is also shown.

six men can now produce the same output as previously required ten men, and the costing system is of such a nature that the products are effectively controlled as regards both price value and quality. Every batch of articles which passes through the works is carefully costed, and any variation of costs is at once brought to light and investigated by the Costs Committee. Such variations may be due to a variety of causes—the stoppage of a machine, the absence of a foreman, material of lower quality, &c.—and in every case the cause is sought and traced home to its origin.

In carrying out the system, the accountant's office, the works manager's office, and the material planning office are mainly concerned. The last two are situated in the works, and, in addition, each foreman has an office fitted with racks for cards and provided with a telephone.

The ideal aimed at in conducting the business is that all goods shall be delivered at once from stock, and this is so far achieved that 75 per cent. of orders are filled in this way. Hence it is necessary to maintain a stock of each item, which is never allowed to fall below a certain minimum before a fresh batch is put in hand. This involves the issue of a "sanction" for a quantity which, in the case of the smaller devices, comprises many thousands of complete switches or fuses. The requisite supplies of raw material, castings, screws, &c., are ordered to comply with the sanction—raw materials are never ordered for stock, but only for a definite "sanction"—and work is commenced on the components, which pass into store as they are completed. The term "components" is not restricted to individual parts; porcelains fitted with fuse-clips, for example, whilst built up of components, themselves become components for the assembly shops. No works order is released until all the necessary material is ready in stock, and in this respect, as in many others, the material planning office, which is regarded as the "brains of the works," plays an important part. The purchasing department sends a copy of each order to the stores receiving office, where the incoming materials are checked; corresponding vouchers are forwarded respectively to the records office, and to the material planning office, where a card index of details for each of the 16 sanctions now in progress is kept, and where the staff is able to trace the exact location of all materials and components and the progress made with each works order. The completion of every batch of products is reported to the material planning office, which releases them for sale by order to the dispatch department or passes them into stock as the case may be.

When a works order is released for fulfilment, the whole of the components required by each workman are conveyed to him, with the appropriate "tally," and he wastes no time in journeys about the works. Several inspectors are constantly on duty to ensure that avoidable delays shall not occur.

All tools are controlled by a system of card indexes, which shows not only the purpose of a tool, but also its condition, and its position at any time; the preliminary study carried out by the production engineer not only determines the time to be allotted to each operation, but also specifies the tools, jigs, &c., that will be required by the operator. All workmen's time is booked up to specific jobs, and idle time is all checked; the amount of time saved, and the corresponding bonus earned (almost invariably the work is done in less than standard time) are entered on cards, which also provide for the allocation of the "burden"—standing charges which in the aggregate vary little with the output of the works, but which vary considerably in respect of each job, in accordance with the time spent on it, and with the number of items over which they have to be distributed.

It is here that the system reaches its highest development; unless the expense burden can be accurately allocated, the true cost of the products cannot be correctly ascertained. But in these works the subject has been closely studied, and the data used are constantly being revised and checked in the light of actual results; every line of work is accurately costed to a minute fraction of a penny, so that the management is constantly kept informed as to the actual position, the progress made in reducing costs from week to week, and the opportunities that remain open for improvement. The reduction in labour of 40 per cent., already mentioned, due to the operation of the system, in itself would justify its introduction.

Seeing that the annual expense burden which is to be distributed over the whole of a year's output cannot be accurately known in advance, it is necessary to base it upon previous results, and to make such allowance as experience and judgment show to be necessary. If the output is increasing, naturally the burden per item diminishes, and *vice versa*. This is the most difficult

part of the system to operate, but in these works the methods devised for dealing with it have been very highly elaborated, to such an extent, in fact, that the cost accounts are balanced from week to week, and any discrepancy is at once brought to light. Thus the management knows at any time not only whether the business is being carried on at a profit, but also the rate of profit which is being earned. In many businesses it is impossible to gauge with certainty the results of the year's trading until the year is complete and the accounts have been made up—a vastly inferior position to be in. That a large costing and accounting staff, and an elaborate system of card indexing and card recording, are necessary goes without saying; but the company is satisfied that the system is not merely well worth the trouble and expense involved—it is indispensable to the obtaining of the maximum production at the minimum cost.

Similar orderly methods are pursued in the external relations of the company; every order is dealt with in such a manner that the date promised for delivery is kept in view, the actual progress made in filling it is constantly known, and at every stage any inquiry that the customer makes can be at once replied to. Machines are freely used for computation, and every process is more or less self-checking. Prices are catalogued in £ and decimals of a £ for foreign purchasers, to facilitate quick conversion into local currency in accordance with the exchange rate of the day.

The latest development in a technical sense is the production of a new range of switches, together with many improvements on the existing patterns of fuse and distribution boards. All switches are put through a flash test at 2,000 volts. Special care is taken to ensure that the finished products reach the customer in good order; small articles are packed separately in cardboard cartons labelled with the capacity and voltage of the contents, whilst larger ones are wrapped in brown paper and labelled. The output of finished products is two to three tons daily, but owing to the precision and order with which the work is carried on, there is no sign of hurry or confusion in any part of the works. It should be observed that although the organisation is so highly developed, the system in no way restricts the introduction of new designs or the improvement of old ones; the advantages of standarisation in expediting output are secured without the sterilisation of inventive ingenuity. A tour of the works, and an inspection of their organisation, is an experience of great interest, and leaves the impression that scientific management is not here a mere fetish, but an ideal at which the company continually aims; nothing, indeed, struck us more than the keen interest displayed by the leading members of the staff in the working of the system, and the pardonable pride with which they demonstrated its efficiency. But anyone who obtains permission to study the details of the system may be warned that it cannot be done in a day.

THE SCAR HOUSE HYDRO-ELECTRIC SCHEME.

BRADFORD WATERWORKS 300-KVA INSTALLATION.

THE Bradford Waterworks Committee possesses storage reservoirs for water supply in the Valley of the Nidd, and recently it has been found necessary to construct a further reservoir at Scar House, near the head waters and just below the existing Angram Dam, in order to provide additional storage capacity.

The construction of the new reservoir involves the building of a very large and important masonry dam, which will be known as the "Scar House Dam," and in order to provide the necessary energy to operate the cranes, blondins, crushing plant, and various machinery involved in this construction, Mr. Lewis Mitchell, M.Inst.C.E., F.G.S., waterworks engineer to the Bradford Corporation, with characteristic foresight, conceived the idea of utilising the water flowing from the Angram Dam Reservoir to operate a hydro-electric plant for this purpose. The water from Angram flows into the River Nidd, and about two miles down stream from the Angram Dam it is conveyed from that stream into the Rainstang Tunnel, through which the water passes to the Bradford service reservoirs.

Messrs. Vickers, Ltd., secured the contract for carrying out this work in November, 1920, and the inauguration of the plant took place on December 7th.

The two Francis turbines installed were made by Messrs. Vickers, Ltd., at Barrow-in-Furness, to the designs of their associated firm, Messrs. Ateliers des Charmilles S. A., Geneva (late Piccard Pictet), and each is designed to operate under a net head of 168 ft., giving an output of 295 b.h.p. and a discharge of 19.5 cu. ft. per sec. at a speed of 1,000 r.p.m., but owing to the possible variations in the water level in the Angram Reservoir, the turbines are also capable of working under a head of 207 ft., giving the same output but a correspondingly reduced discharge, or under a head of 148 ft. with correspondingly reduced output.

The guaranteed efficiency under a net head of 168 ft. was as follows, subject to a tolerance of plus or minus 2 per cent.:—At full load (295 b.h.p.), 79 per cent.; at $\frac{7}{8}$ load, 80 per cent.; at $\frac{3}{4}$ load, 79 per cent.; at $\frac{1}{2}$ load, 76 per cent.; but when tested recently the efficiency of the turbine at full load worked out at 86.5 per cent.

The turbines are governed by two oil-pressure governors (Piccard Pictet patents), which work each in conjunction with a relief valve; that is to say, each turbine has its own governor and its own relief valve owing to the considerable length of the pipe-line used. The result of this is that, if the load is suddenly thrown off, the relief valve opens very quickly, beginning to open before the governor commences to close the turbine gates, after which the relief valve closes very slowly, taking between 80 and 100 seconds to do so after opening in from 2 to 3 seconds, thus ensuring that the over-

FIG. 1.—EXTERIOR OF GENERATING STATION.

pressure in the pipe-line will not exceed about 14 per cent. of the final static head.

The general arrangement of the generating sets is well shown by figs. 2 and 5.

In the power house each of the water turbines drives by means of a semi-elastic coupling, an open type three-phase generator with an over-hung exciter; each machine is capable of giving a continuous output of 250 kVA at 0.8 power factor, 2,400 volts, 50 cycles, 1,000

r.p.m., and each generating set has been tested at an over-speed of 80 per cent. The excitation voltage is 110, and the efficiency at full load and 0.8 power factor of each generator is 93 per cent. A flywheel is provided for each generating set in order to prevent the use of the more expensive electrical machines which would be necessary if the whole of the flywheel effect required were embodied in the rotating members of the alternators.

The energy is conveyed to the switchboard by single-core, rubber-insulated, 3,300-volt Association

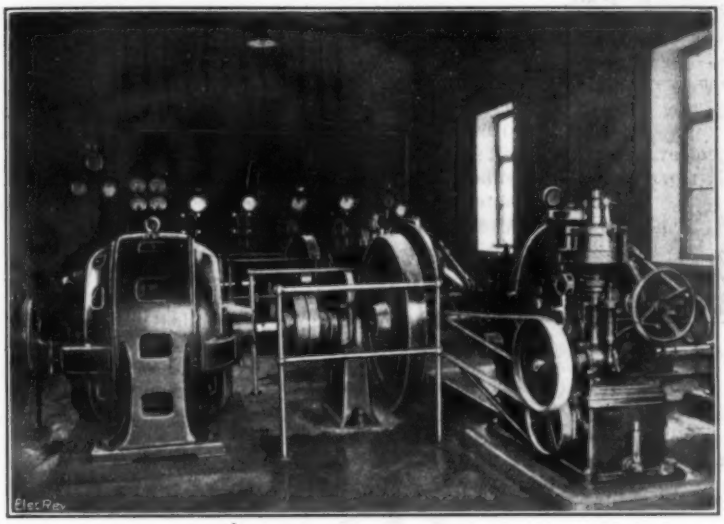


Fig. 2.—Interior of Power House.

grade cable made by Messrs. W. T. Glover & Co., who have supplied all the cable connections needed for this contract. The six-panel switchboard, by the Metropolitan-Vickers Electrical Co., comprises a synchronising bracket, exciter cubicle (controlling the two exciters), two generator cubicles, two feeder cubicles (each of which is capable of dealing with the full output of the station), and, finally, a voltage regulator and lighting cubicle. The lighting supply for the power house is furnished by a 0.5-kVA, single-phase transformer. The apparatus on the two outgoing feeders comprise isolating links, choking coils, and lightning arresters.

The whole of the electrical equipment in the sub-stations was supplied by the Metropolitan-Vickers Electrical Co., Ltd.

Sub-stations Nos. 1 and 4 are duplicates of one another as far as equipment is concerned, although the position of No. 4 is not as yet settled, as it depends upon the final choice of the quarry site. Each of the sub-stations contains four 50-kVA, 3-phase transformers, with a ratio of 2,200/440 volts. They are star/star connected and oil-immersed in corrugated sheet-iron tanks of the self-cooled type. Each of these two sub-stations will contain the necessary isolating links, lightning arresters, and choking coils on both the h.p. and l.p. sides. As regards switchgear, on the h.p. side there are four 50-kVA transformer cubicles, while on the l.p. side there is a three-panel switchboard, two panels of which will each control two 50-kVA transformers, and the third panel will deal with one 50-kVA and one 200-kVA feeder.

Sub-station No. 2 has to supply power to the workshops and blondins, &c., as well as to a proportion of the cranes on the dam; it is of larger capacity than sub-station No. 1, though in general arrangement it is very similar. It contains five 50-kVA transformers and five h.p. transformer cubicles. The l.p. switchboard consists of four panels, two of which each control two 50-kVA transformers, while the third deals with one 50-kVA transformer and one 100-kVA feeder, and the fourth panel with two 200-kVA feeders.

Sub-station No. 3 is of a different character from the others, because it is intended solely for lighting. To meet the requirements of the Bradford Corporation Waterworks engineers on the site, the lighting is to be done at 110 volts direct current, and the sub-station comprises the following equipment:—

The h.p. line is brought in to a cubicle which controls a 25-kVA transformer that feeds a 20-kW motor generator, which can either charge the battery or supply energy for lighting direct. As a stand-by and for use when the water turbine is not running for any reason, a belt-driven 20-kW generating set is provided with a 35-h.p. Vickers-Petter's semi-Diesel engine fitted with an electric starter and compressed air apparatus, to run on crude oil; this generating set is also capable of either charging the battery or supplying the lighting circuits direct.

As an annexe to this sub-station there is a battery room containing 60 Chloride accumulator cells in glass boxes, which, when fully charged, will give a discharge of 979 ampere-hours in ten hours to a final pressure of 1.83 volts per cell, 816 ampere-hours in five hours to a final pressure of 1.78 volts per cell, or 701 ampere-hours in three hours to a final pressure of 1.75 volts per cell. The ampere-hour efficiency of the battery is 90 per cent. at all rates, while the watt-hour efficiency is 75 per cent. at the ten-hour rate.

Portions of the pipe line between the power house and the Angram Dam are shown in figs. 3 and 4. There are two connections to the Angram Reservoir, and an air valve is provided to free any air which may collect in the pipe, and to allow the escape of air when the pipe is being filled; this valve also prevents the formation of a vacuum in the pipe-line if the latter is emptied too quickly. The 30-inch diameter pipe is approximately 312 ft. long; following this, there is a section approximately 1,484 ft. long of 35-in. bore pipe 3/16-in. thick; this, again, is followed by a section approximately 1,488 ft. long of 33-in. bore pipe, while the

Fig. 3.—Portion of Pipe Line.

final length is approximately 1,491 ft. long and the total length of the pipe-line is 4,775 ft., the pipes being of the mild-steel welded type with flanges riveted on to them.

Concrete anchor blocks, anchoring rings, and expansion joints are provided, and the pipe-line is supported on rubble masonry piers and concrete saddles, free movement being allowed for by inserting tough brown paper served with black lead and tallow between the pipe and the concrete saddles. The pipe-line in its

course to the power house follows approximately the path of the River Nidd, which it crosses five times, temporary wooden bridges being erected at the crossings. The pipes after erection were painted with special paint supplied by Messrs. Cuirass Products, Ltd.

Fig. 4.—Angram Dam and Portion of Pipe Line.

A maximum movement at the expansion joints, during this autumn when the pipe was empty, has been observed of $3\frac{3}{4}$ in. during one 24 hours when it was hot in the valley during the day and very cold at night. Just before entering the power house a small 2-in. drain valve is provided in the bottom of the pipe-line to drain the last section, if it should ever be required to empty the latter completely. In case the power house is shut down completely for any reason a 5-in. discharge valve is connected by a tapered pipe to a 15-in. pipe that discharges into the River Nidd, because in ordinary operation the water supply to the City of Bradford will go through the turbines, and if they are not running for any reason the water supply must, of course, continue.

In this connection it is interesting to note that the ordinary consumption of water from the Angram Reservoir is 13 cu. ft. per second over 24 hours. As it is required to get as much energy as possible during eight hours out of the 24, the turbines were designed to utilise approximately three times the above amount.

The joints between the pipe-line flanges, which are bolted together, are made with a rubber jointing material that was supplied by the Ioco Rubber and Waterproofing Co., Ltd.

A large portion of the material for the transmission lines was supplied by Messrs. Twiss Electric Transmission, Ltd., wooden poles of the "A" and "H" descriptions being used. Stranded copper conductors are used, and a continuous earth wire is provided throughout. Suitable cradles and triangular guards are provided where either roads or railways are crossed by the 2,400-volt transmission line, which is strongly guyed and supported owing to the heavy wind and weather conditions which frequently obtain at the head of the Nidd Valley, but there is nothing remarkable about it, except its simplicity. Isolating switches are provided on each terminal pole, at the various sub-stations and on each of the two terminal poles at the power station, so that any section or building may be completely isolated.

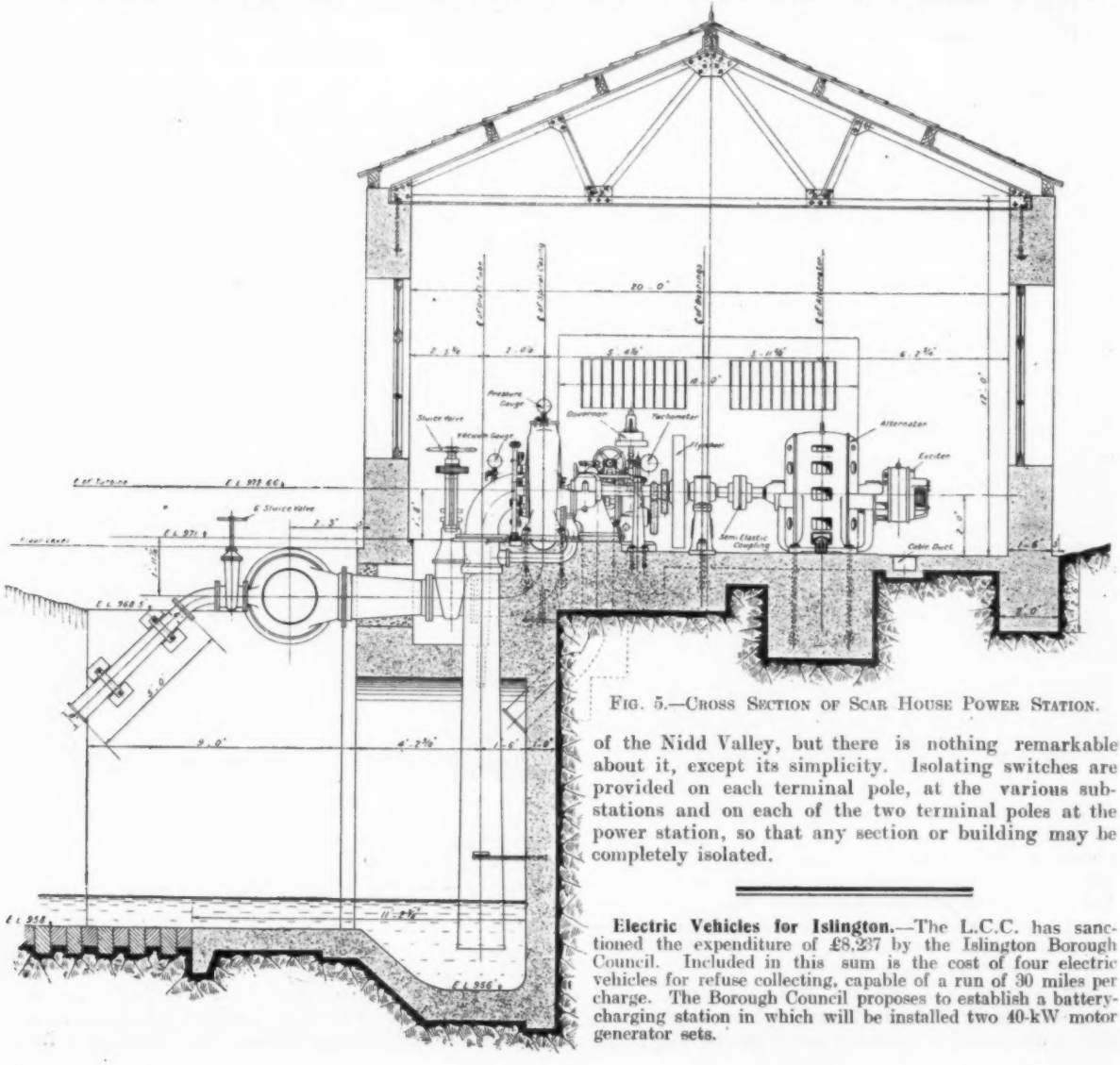


Fig. 5.—Cross Section of Scar House Power Station.

Electric Vehicles for Islington.—The L.C.C. has sanctioned the expenditure of £8,237 by the Islington Borough Council. Included in this sum is the cost of four electric vehicles for refuse collecting, capable of a run of 30 miles per charge. The Borough Council proposes to establish a battery-charging station in which will be installed two 40-kW motor generator sets.

"HANDS OFF" THE ELECTRICAL INDUSTRY.

The Institution Lays the Matter before the Premier.

In our leader columns again to-day we discuss the German desires that reparations in kind may be permitted to take the form of electrical power stations and railway electrification in the United Kingdom, and the schemes under which it is hoped to establish a permanent German electrical and other manufacturing hold upon Russia. It is as well that the subject of reparations in kind in relation to France and Russia, and the present and future state of British electrical export trade, should receive attention in its entirety and by all classes of the community.

It is not a matter to be left in the hands of statesmen and politicians—it vitally affects the interests of whole communities engaged in industry and trading. It is a matter of the utmost seriousness for working men and working women, because it threatens the British manufacturing position when confidence in the future of our industries is most necessary for reviving trade and increasing employment. The subject is a most suitable one for co-operative action between employers and employed, and we are pleased to see that such action has been taken. We hope the whole story will be related by trade-union officials to their members in the interests of the industry that affords them their livelihood. It is often said that we are backward with regard to convincing propaganda. Here is a plain straightforward subject indicating beyond dispute where the interests of all classes lie.

The harm done by the speech of Sir Peter Rylands in singling out our power supply and our electrical industry for attention cannot be estimated at the moment. Measures were promptly taken by the Press and by leading representatives of the industry to see that Ministers of State were not blind to the dangers that beset their path if they dallied with such projects.

We are glad that the Council of the Institution of Electrical Engineers has seen fit to bring its weighty influence to bear upon the mind of the Prime Minister with regard to the matter. The statement sent to Mr. Lloyd George, signed by Mr. Highfield as Presiden, is reprinted herewith. It will be found to deal first with the principle of reparations in kind and the importance of their not being permitted to interfere with British employment. It proceeds to correct the impression that may have arisen from the speech of Sir Peter Rylands that cheaper transport and power would be rendered available by the carrying out of the German plans. It emphasises the needs of the British electrical industry which is at present running its works in expectation of a trade revival, and the disadvantageous position in which it would be placed in the export markets if German productions were officially accepted on a large scale, forming for them a world-wide advertisement. The experience of the British nation during the war demonstrated the need for electrical engineers of the highest skill for manifold kinds of vital service. The Institution having had a large part to play in organising our human scientific resources in this connection can justly claim the right to speak to the Premier, who did so much to win the war, with a voice of authority. The Institution, in its communication, does not mince matters. It uses the word "*ruin*" for Britain as the consequence of a large German electrical reparations payment.

We believe that in the views stated in this letter the Institution Council speaks what is in the mind of all grades of its membership and acts in the interests of the hundreds of thousands of professional men and employés engaged in the electrical and allied industries.

We hope that the Government will adopt the Institution's advice and make a pronouncement as soon as possible in such clear and definite terms as shall bring about a complete restoration of confidence.

(COPY.)

THE INSTITUTION OF ELECTRICAL ENGINEERS.
Founded 1871.
Incorporated by Royal Charter, 1921.

Savoy Place,
Victoria Embankment, London, W.C.2.
9th December, 1921.

The Right Honourable David Lloyd George, O.M., P.C., &c.,
First Lord of the Treasury,
The Treasury.
Whitehall, S.W.1.

Sir,

GERMAN REPARATIONS IN KIND.

The Council of the Institution of Electrical Engineers have had their attention directed to certain public declarations and Press communications proposing that the German Reparation Indemnity should be partly provided by the construction in this country of generating stations and the carrying out of railway electrification by German contractors; and, having appointed a Committee to report to them thereon, desire to put before the Government their considered view on these proposals as follows:—

On the general principle of reparations in kind, they have to remind the Government that at the present time, when unemployment is so extensive, any reparations in kind should be of such a nature that they do not compete with any productions in this country involving employment on a great scale of labour, both skilled and unskilled.

With regard to the proposals that large electric power stations should be erected and that railway electrification should be undertaken by German contractors, they desire to make the following observations: It is possible that the proposals for the acceptance of German plant on account of reparation may have arisen from a hasty impression that such action would confer benefits on this country in the form of cheaper transport and power. But if such plant is to stand as a contribution towards reparations its value must be debited to the undertakings using it. In no other way can such value be put to the credit of National indebtedness. There is, therefore, no good reason to suppose that the use of German plant obtained in that way would result in the users of it being able to give a cheaper service than with new equipment of British manufacture.

There are, however, other considerations which my Council desire to urge. The electrical industry in this country is at the present time suffering from a grave lack of employment in all branches, but nevertheless many works are being run in the expectation of a trade revival. Should it be decided to accept German machinery on a large scale, there is no doubt that a large additional amount of unemployment would immediately result, and that both the workpeople and technical staffs at present being kept together would be disbanded. Moreover, the effect of the acceptance for the public service of this country of electrical machinery of German manufacture would be a world-wide advertisement for such goods, and would fatally diminish the present prestige of British electrical goods, with most serious effects on our export markets.

The experience of the war showed the necessity of this country having a large number of highly skilled and trained electrical engineers available, and the members of the Institution of Electrical Engineers were called upon during the war to undertake work for the national forces requiring the highest skill.

A proposal which would have the effect of crippling many of the most important electrical manufacturing concerns and leaving this country dependent for electrical services upon German industry would result in discouraging the training of electrical engineers for what, in war time, is a vital necessity.

In view of the points briefly set out above, the Council of the Institution of Electrical Engineers, representing all branches of the electrical industry, desire to urge most strongly on H.M. Government the disastrous consequences which would ensue to the industry if electrical construction in this country on an extensive scale is entrusted to German manufacturers. Any possible immediate advantage anticipated by the proposers of the scheme of reparation could not off-set the ruin of those industries in this country which are engaged in the manufacture of steam turbine plant and heavy electrical machinery, both of which had their sole origin in British science and inventiveness.

The Council of the Institution trust that in view of the discussions which have been published, H.M. Government will remove the great uncertainty which has been created in the industry by an immediate statement that such proposals will not be entertained. If, however, proposals of the kind should be considered by the Government, my Council ask that they should be given an opportunity of being heard by yourself or the Chancellor of the Exchequer before any action is taken.

I am, Sir,
Your obedient servant,
(Sgn.) J. S. HIGHFIELD,
President.

The matter has also been dealt with by a meeting of representatives of the Joint Industrial Councils and other bodies in the electrical industry, as the following quotation from the *Daily Telegraph* (December 14th) will show :—

"With reference to the suggestions made that the German reparation indemnity should be partly provided by the construction in this country of generating stations and the carrying out of railway electrification by German contractors, a meeting has been held representative of the Joint Industrial Councils and other bodies in the electrical industry, and comprising therefore both the trade unions' and the employers' side of these matters, at which the subject was discussed. A resolution adopted by the meeting called 'attention of the Government to the irreparable injury which would be done to the British electrical industry now and in the future if any such proposals were seriously entertained, and which if put into effect would result in the closing down of important electrical works in this country and consequent increase of unemployment.' The conference further invited the Government to make an immediate and unequivocal statement that acceptance of reparation payments by handing over such public service works to German contractors will not be entertained."

AN ELECTRICAL REVIEW OF E.-H.-P. TRANSMISSION.*

BY R. BORLASE MATTHEWS,
Wh.Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

(*Concluded from p. 797.*)

(II.) *The Mechanical Construction of e.h.p. Lines.*

While there does not seem to be any official definition, on the Continent, all lines operating at 40,000 volts or over, are usually classed as extra-high-pressure. At a conference held at Brussells in 1920, an attempt was made to standardise the line voltages as 45,000, 60,000, 80,000, 100,000, and 120,000 volts, with proportionately higher voltages at the generating stations. However, this proposed standardisation did not meet with the approval of the French engineers, and seems to be as yet undecided. A fundamental factor underlying this question is the relation between the pressure, the length of the line and the amount of power to be transmitted. With these main variables, and also associated with them a number of minor variables, it is little to be wondered that recent discussions have thrown into relief the extreme complexity of the matter. Of course the main object is to obtain a design of line, that not only functions properly, but also operates economically. The cost price of the transmission must, of course, be as low as possible, taking into account the losses of energy and the annual overhead charges for depreciation, operation of the line and of the necessary stations. French engineers have attempted to design the ideal line on a mathematical basis, not, however, with much success, as there are so many variables, not the least of which is the fluctuations of market prices of materials. On account of the cost of installation, maintenance, and consumption of synchronous condensers, Lavenchy, in his paper, favours aiming at a power factor lower than unity, even though a high power factor would reduce the line losses and the necessary capacity in kilo-volt-amperes of the transformers and alternators. As regards the maximum power which can be transmitted by a three-phase line for a given voltage, Blondel is quoted as having demonstrated that, all other things being equal, the maximum power that a line can transport is proportional to the square of the voltage at the generating extremity. Continental engineers seem to have adopted Lord Kelvin's rule, as a first approximation in deciding the most economical section of a line, viz., as that for which the annual interest and depreciation on the conductors and such part of the supports, &c., as varies with the section of the conductors are equal to the price of the energy consumed annually by ohmic losses. This rule does not of course take into account possible future expansion of supply. Further, pole costs often increase out of proportion as the conductor section increases, hence the cross section finally selected is usually a trifle less than that called for by the application of the rule. Based on Still's (U.S.A.) formula, Lavenchy has prepared an interesting abacus, which quickly indicates the required voltage for the transmission of a given amount of power over a given distance, *e.g.*, if 26,000 kW has to be transmitted 280 km. (175 miles), the abacus gives the required voltage as 115,000. 200,000 volts is considered to be the present practical limit of pressure for transmission under European conditions. Even this pressure would only be advocated for considerable power, with high load factor and long distances.

Except for temporary work, wooden poles for transmission lines operating at over 45,000 volts have been superseded by either reinforced concrete or steel poles. The reinforced concrete poles are largely employed on lines of 45,000 to 65,000 volts. They are considered to be the type of pole which requires the least maintenance. Their excessive weight is, however, especially in mountainous districts, a serious obstacle to their use. These concrete poles are made in every conceivable cross section. The heights of the steel poles are usually 28 to 30 feet, for a 45,000-volt line carried on pin insulators; or for a 120,000-volt line with six conductors, carried by insulators of the suspended type, the heights are normally 75 to 80 feet.

Anchor poles are usually fixed at intervals of about one kilometre. In this way the stringing tension of each section can be adjusted independently.

Most of the lines are nowadays provided with one or two earth wires, in the form of galvanised steel cables. This ground wire not only acts as a protective device, but also provides a good contact from pole to pole, which is useful should any pole be insufficiently earthed. Sheets of copper about two feet square are employed as earth plates (in Holland the plates used are considerably larger). These sheets are bedded in coke, in pits dug outside the pole foundations, so as to permit of easy inspection. The sheets are connected to the poles by No. 0 A.W.G. copper wire.

As a means of economy in constructing the concrete foundations for poles a central hole is left, which is filled up with stones. Occasionally iron shoes are employed as pole foundations, in place of concrete. A curious trouble has arisen in Holland, where the poles were painted with iron oxide paint, in that the cattle lick off the paint on account of its sweet taste, and thereby are poisoned. The question which is the best method of preserving a steel pole is by no means settled, *i.e.*, whether it should be painted or galvanised, and, if the latter, which process should be adopted.

As regards insulators, the pin type is usually employed up to 70,000 volts, and above that pressure the suspended pattern is almost exclusively employed. The pin type insulators usually consist of at least three parts cemented together. Often they are formed of four or five parts. Their dimensions vary from a diameter of 270 mm. (say 10¼ in.) and a height of 300 mm. (say 12 in.) for 45,000 volts, up to a diameter of 350 mm. (say 14 in.), and a height of 415 mm. (say 16¼ in.) for 75,000 volts.

In the case of suspended insulators, six are employed for 90,000 volts, seven for 120,000 volts, and eight for 150,000 volts. Experimental work has shown that if the dielectric strength of insulators could be improved, it would be much more satisfactory to employ three only. This is for the reason that 50 per cent. of the potential distribution along the chain occurs at the first insulator, and 25 to 30 per cent. at the last, the intermediate insulators only averaging 5 per cent. A suggestion has been made to improve the potential distribution by employing metallic covers (which also serve to improve the rain protection) over each insulator in a chain. A very uncertain problem in the manufacture of insulators is the ageing of the porcelain. Also it is difficult to manufacture these insulators of any considerable thickness without the possibility of developing flaws. After four or five years the life of insulators becomes very doubtful, and they then need very careful watching and testing.

While very careful investigation has been made as to the relative advantages of copper and aluminium for overhead conductors, the situation may be summed up by saying that they are interchangeable for average spans, and there is no other metal that can be substituted for them. On long spans either of these metals is employed, with a twice galvanised steel centre core for strength—its conductivity is not taken into account. In an aluminium-steel cable the weight of the steel approximates 50 per cent. of that of the aluminium. In California 800 ft. has been calculated to be the most economical span for a three-conductor aluminium-steel line (cross-section 700,000 c. mils) for a load of 100,000 kW at 200,000 V. In one transmission system, at any rate, the line is carried in roller bearings attached to the insulators on the poles between the anchor poles. (This is in Holland.)

Great improvements have been made of late in the construction of underground cables for operation at 45,000 volts and over. Messrs. Callender's have actually supplied 50,000-volt, 3-core cables to Holland. In France the tendency seems to be to lay single-core cables, lead-sheathed, but without steel armouring to prevent induced eddy currents. This method reduces the stress on the dielectric material, and avoids corona troubles. Further, an extra single conductor cable can be laid at the same time at a small additional cost, as a spare. The jointing is also much easier. Still, the three-core cable seems to be more of an engineering proposition, and if the cable is solidly filled, *i.e.*, no space left between the three cores, there is no fear of corona trouble with its consequent weakening of the dielectric. Further, these cables can be made with steel armour, which is undoubtedly an advantage as a mechanical protection. It is anticipated, as the result of tests now in progress, that shortly it will be possible to manufacture 120,000-volt cables.

(iii.) *The Operation and Protection of e.h.p. Lines.*

A somewhat curious fact came to the attention of the writer when in Holland recently. A large number of cables have been laid in that country, at a cost which compared

* A continuation of notes on the recent International Conference held at Paris.

favourably with overhead lines—owing to the difficulties in importing both poles and insulators. The distribution system has been laid down considerably in advance of the demand, with the result that on a Sunday morning a station with a normal week-day load of 5,000 or 6,000 kW has to operate a 1,400-kW steam turbine set to supply the wattless current due to the capacity of the cables.

On the Continent it seems to be the custom to maintain a close and regular inspection of the lines, *e.g.*, a weekly visit is paid to each pole during the summer, and a bi-weekly visit during the winter. All details affecting the line have to be reported upon. Watchmen's time-clocks (into which a key has to be placed and turned to record the time of a visit) are fitted to the poles at the wireless station at St. Assisse. In addition, a night inspection is made once a month to detect any corona and brush discharges which may occur at defective points.

Owing to the uncertainty as to the life of insulators, periodical tests have to be made. These are carried out either by (*a*) the megger method; or (*b*) the buzz-stick method. For the megger test the line has to be dead, which is a disadvantage. In addition, the test does not seem to be effective on certain types of insulators. The buzz-stick method, as may well be anticipated from its name, comes from America. The testing appliance consists simply of a 10-ft. insulated rod, of about 1¼ in. in diameter. At the upper end of this pole a metal fork is fixed, whose prongs are about a foot apart. The test is carried out in two stages: (1) "feeling-out," and (2) "shorting-out." The first test consists in touching successively with one of the prongs of the fork, first the conductor and then the head of each insulator. On withdrawing the fork a characteristic buzzing sound is heard, which diminishes as successive insulators are touched (of course the buzzing will increase slightly at the last insulator, as compared with the intermediate ones, as the potential gradient is greater there). If this test indicates that the greater proportion of the insulators in a chain are faulty, the second, or "shorting-out" test, must not be applied. The "shorting-out" test consists in successively short-circuiting all the insulators in a chain by means of the fork. An arc will be made, when making and breaking the short-curcuit, if the insulators are sound. The arcs decrease (in a good chain) as in the case of the "buzz" test. Similarly, the arc produced on the last insulator is greater than on the penultimate one.

It is found that an earthed overhead guard wire is the best protection against lightning. Many other, and more complicated methods have been employed, but, as a rule, they are being gradually discarded. The horn-shaped lightning arrester, though still employed on medium-pressure systems, is entirely eliminated from those of extra-high pressure. Electrolytic arresters—which are really valves—are used to a considerable extent in America. There are also a few installations in Europe, though they have a number of disadvantages. Wave-damping devices, in the form of condensers, are favoured in Central Europe.

In the maintenance of effective service on an e.h.t. transmission system, the use of the telephone is of all importance. Latour and others have given considerable attention to this matter, and the systems they advocate include the use of three-electrode vacuum tubes. On independent telephone lines these electronic tube amplifiers super-amplify the speech signals, so that the latter eclipse in strength the disturbances due to the neighbouring high-tension lines. The other scheme is the high-frequency method of telephone communication over the high-tension lines. This apparatus is often associated with wireless telephony, since both the sending and receiving apparatus are similar.

(IV.) *Legislation Affecting e.h.p. Lines.*

Of late most countries have been revising their laws, to permit of the installation and operation of lines at higher pressures than had previously been conceived. At the Paris Conference reports were made as to the form of these laws, a summary of which should be useful to legislators, and for the convincing of tardy legislators by those who appreciate the real necessity for a nation to have a cheap supply of electricity.

The question as to the best arrangements for dealing with and compensating land owners for setting up poles and crossing their land is a very thorny one. No country seems to have solved it legally except Germany. There it is merely a question whether or not a line is to the best interests of a community. If it is, the land owner gets ridden over rough-shod, without any concern for his feelings or pocket. As a matter of fact it is eventually as much to his interests as to others, to have an ample supply of electricity available. However, the Government has decided that the coming of an electric line shall not enrich the land owner at the expense of his neighbours. After all, it is but chance that he happens to own land over which a line passes—it is certainly not due to any enterprise on his part. Apart from legal powers, negotiations with landowners seem to be most easily effected in countries where the co-operative idea is well implanted, such as parts of Denmark and the Netherlands. Further, these countries have already discovered what a valuable thing it is to have a supply of electricity available for everybody—even for the farmer—which is a stage considerably in advance of most other countries up to the present.

As a matter of interest it may be mentioned that in France steel pole rights are purchaseable for 30 to 100 francs; anchor pole rights vary from 80 to 130 francs; for the crossing over of the line a franc per 10 meters. Wood pole rights are generally arranged at about 10 francs, with 20 francs for anchor poles. In forest land it generally costs about 300 francs per pole, as trees, &c., have to be cleared. In vineyards two to six francs is paid for each vine plant that has to be removed.

In Conclusion—

The general impression that the writer gained from the Paris Conference was that European engineers do not know as much about extra-high-pressure lines as is known in America. Further, this class of work seemed generally to be a part of the work of a busy engineer, who also had charge of a complete local system of supply, *i.e.*, the generating station and low-pressure distribution network, &c., of a city or town. His interest in extra-high-pressure work arose from the fact that, generally, the conclusion is that, as generating stations become larger and larger, and the generating units likewise, it is not so economical to provide for spare plant in case of mishaps. Hence it is becoming necessary for these stations to link up with each other. It is most pleasing and interesting to note this spirit—which, after all, is in the best interest of the populations they serve. Even municipal jealousies on the Continent seem to be getting suppressed (even though it may be slowly) in a genuine effort to attain this ideal. It is to be hoped that the same thing will soon occur in England.

The promoters of the Paris Extra-High-Tension Conference are to be congratulated upon the great success of their first meeting. Undoubtedly this first general interchange of ideas between nations on this subject will lead to even more effective progress at the next meeting, for they have all, as it were, thrown their cards on the table, and disclosed the main lines upon which they are working. On this basis it is to be anticipated that next year's papers will be less insular (if it may be so described) in tone.

The proceedings of this Conference will be published in February next, both in the French and English languages, at 50 francs per copy. Copies may be ordered from the secretary of the Conference, 7, Rue de Madrid, Paris. This book should prove to be a very useful and interesting compilation.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR NOVEMBER, 1921.

In most respects the Board of Trade statistics for November varied but slightly from those for October. There was a small increase under all three main heads. The only noteworthy single item was the value of exported motors and generators, which showed an increase of nearly £100,000. The "Imports" section revealed increases in the items Electrical Machinery (unenumerated); Switchboards, and Batteries. The increase in the total value of re-exported goods was fairly evenly distributed among the constituent items.

Values of Electrical Exports and Imports for November, 1921.

	Exports.	Imports.	Re-exports.
	£	£	£
Electrical goods and apparatus	119,486	49,914	3,819
Insulated wire	207,414	18,034	109
Glow lamps	27,957	21,505	444
Arc lamps and parts	781	414	—
Batteries	38,186	12,285	—
Meters	33,236	2,137	804
Carbons	5,668	1,215	1,503
Electrical Machinery:—			
Railway and tramway motors...	6,373	—	—
Other motors and generators	275,553	—	—
Switchboards (not telegraph or telephone)	21,839	7,291	105
Electrical machinery (unenumerated)	167,989	46,871	3,438
Telegraph and telephone cable material:—			
Telegraph and telephone wires and cable (not submarine) ...	110,262	2,652	630
Submarine telegraph and telephone cable	42,028	—	—
Telegraph and telephone instruments and apparatus ...	184,738	17,389	3,901
Totals	£1,240,810	£179,707	£14,753

Employment in Lead Processes.—The Stationery Office issued, on December 8th, Factory Form 616, the approved form of Health Register for women and young persons employed in processes involving the use of lead compounds.

LEGAL.

Postmaster-General v. Mayor and Corporation of Liverpool.

As briefly reported last week, Mr. Justice Shearman and Mr. Justice Salter, sitting as a Divisional Court of King's Bench, continued the hearing of the appeal by the Postmaster-General against the judgment of the Liverpool County Court Judge regarding a claim for the recovery of the cost of repairing certain damage to telephone plant belonging to the appellants caused by the Corporation's electric light mains.

Mr. Justice Shearman, on the case being called, said that the Court, after having considered the case, did not wish to hear appellants' counsel in reply to the case for the respondents. In giving judgment in favour of the Postmaster-General, his Lordship said the Court agreed with the finding of the County Court Judge that there was proof of nuisance. It might have been dangerous in itself, but the defence on that point was such as to prevent the action being successful in the claim for damages. Regarding the agreement entered into in 1886 between the National Telephone Co. and the Liverpool Corporation, it had been shown that while the Postmaster-General held a monopoly of the business of telegraphs and telephones for the State, he was authorised to issue licences, which had been done in this case to the National Telephone Co. This licence expired in 1911. In order to carry out its undertaking in Liverpool, the company came to an agreement with the Liverpool Corporation. This agreement was subject to certain conditions, one of which indemnified the Corporation against injury or damage which might be done by electric light plant. The agreement was entered into before the licence of the Postmaster-General was obtained, and the Court agreed with the contention of the Postmaster-General that he could not be bound by the agreement with the Corporation, to which he was not a party, and which came to an end by the flux of time when the licence to the Telephone Co. ended on the tranference of its property. Under all the circumstances of the case his Lordship said he must hold that there was a proper claim under Section 8 of the Telegraphs Act and on the ground of nuisance. The Postmaster-General therefore succeeded, and the appeal must be allowed with the costs of the appeal.

On the application of Mr. Maugham, K.C., for the respondents, leave to appeal was granted in view, said Mr. Justice Shearman, of the public importance of the case.

Connare v. Thomas.

In the King's Bench Divisional Court on December 8th, Justices Horridge and Shearman heard the appeal of Mr. H. E. Thomas, of Hemel Hempstead, from a decision of Judge Crawford at Watford County Court in an action brought against him by Mr. Joseph Connare, electrical engineer, of High Street, Watford.

Mr. Lawton, on behalf of the appellant, said the action was tried on October 27th. It was a claim by an electrical engineer for work done and the price of goods sold and delivered. The points for legal argument were, first, whether there was any consideration at all to support an oral agreement; and, secondly, where there was any oral consideration, whether that was in law sufficient. Mr. Thomas, the defendant, owned an estate called Hyde Farm, Hemel Hempstead, and started building upon it. He proposed to put up two kinds of villas and bungalows, and it was necessary to install electric light in them. The plaintiff approached him to see if he could get the contract, and an estimate was given by the plaintiff on March 13th, 1920, and accepted for the work to be done at 25s. 10d. per light. That was always the basis of the arrangement. At a later date, in September, a conversation was alleged to have taken place between the plaintiff and the defendant, the effect of which was to substitute for that contract an oral agreement which he was now attacking. It was alleged that the plaintiff said to the defendant that the cost of labour and materials had gone up, and that defendant said "Very well, I will let you off putting the fittings in each house, but I shall never pay you for them." Counsel contended that the Judge was wrong in holding there was any consideration for the oral agreement. He denied that there was any further agreement in September.

Mr. H. I. P. Hallett supported the Judge's decision.

Mr. Justice Horridge, in giving judgment, said he regretted that the appeal had been brought, because it seemed to him entirely a question of fact as to the state of the account between the two parties. But a point of law had been evolved out of it, because it was said there was no consideration for the bargain which the Judge had found. In order to support the judgment it was necessary to find that a good agreement was made about September, 1920. The agreement that was alleged to have been made was that the contractor should get the same price for the electrical installation without putting in electric light fittings as he had previously quoted to include electric light fittings, and it was said there was no consideration for that bargain. The Judge's note said "Defendant told me I was not to put up fittings, tenants to pay for them; I was to allow him 15 per cent. commission." The Court could not assume that note to be incorrect upon the mere statement of counsel upon one side which counsel upon the other side said he could not admit. It seemed to his Lordship that the whole case was consistent with there being this consideration, because in November the defendant asked for a new quotation for the work that was to be omitted, and he knew perfectly well that he had made this bargain in September. He (his Lordship) was not going to assume here that the Judge did not consider the question of consideration and found correctly that there was consideration. The appeal must be dismissed.

Chamberlain & Hookham v. Solar-Zahlerwerke.

The *Birmingham Post* reports the hearing of this case of a British company against a German company before the Anglo-German Mixed Arbitral Tribunal on December 9th.

Mr. Douglas Hogg, K.C., said the claim was for £26,921, and interest. There was no serious dispute as to the amount, but there were certain points to be cleared up. The German firm's objections were that its shares were owned by the English firm and that when the shareholders in a German company were English the company was not a German company. It further objected that where the shareholders in a German company were in the position of the claimants there was no debt. Those were propositions which were not in accordance with English or German law or with the provisions of the treaty.

Messrs. Chamberlain & Hookham carried on the business mainly of makers of electricity meters. In 1908, in association with a German firm in Hamburg, a German company was formed, and the respondent company was incorporated with a capital of 50,000 marks held by three or four shareholders, Mr. John Chamberlain holding 30,000. The German company bought from Chamberlain & Hookham the whole of the patent rights in respect of these electricity meters for a number of Continental countries. The price was 49,000 marks, nearly the whole of the paid-up capital. The German company commenced business in Hamburg, its principal business being the assembly and sale of meters made under the Chamberlain patents. The German company did not at first make very much profit, but in 1914 it was apparently getting large orders, and looked like having a prosperous future. In 1912 the whole of the share capital in the German company was owned by Chamberlain & Hookham. At the outbreak of war there was owing to them the amount claimed. Counsel quoted legal decisions of the House of Lords on company law, and held that there could be no doubt that Messrs. Chamberlain & Hookham had the right to say that they had sold goods for which they had not been paid.

The decision will be announced later.

Birkdale & District Electricity Supply Co., Ltd., v. Southport Corporation.

The motion on behalf of plaintiffs, postponed from the previous Friday, was mentioned to Mr. Justice Peterson in the Chancery Division on December 9th. Leave had been given to amend the writ by adding the Attorney-General as a plaintiff, and the Attorney-General's fiat was obtained, but further amendments were asked for. The writ only asked for an injunction to restrain supply and distribution by the Corporation, and it was desired to ask for a declaration. On the motion being called, counsel stated that the parties were not ready and a further adjournment for a week was granted by his lordship.

Shirtliff Bros. v. Albion Mills Co.

An appeal by the Albion Mills Co., of Cable Street, London, from a decision of Judge Jackson at the Mayor's and City of London Court in favour of the plaintiffs, Messrs. Shirtliff Bros., manufacturers of electric baling presses, of Letchworth, came before Justices Horridge and Shearman, sitting as a King's Bench Divisional Court on December 9th.

Mr. G. W. H. Jones, for the appellants, said the claim was for £69, of which £50 was in respect of a bonus agreed to be paid by the defendants to plaintiffs for an electrical baling press for making rags into bales, and £19 as interest upon an acceptance. Judgment was given for the plaintiffs for £50 and £9 respectively. The Judge said it was sufficient if the plaintiffs were ready and willing to make delivery of the machine, and they said that they were, although it was not in fact delivered, and upon that he said they had fulfilled their contract as far as the bonus was concerned, and were entitled to the £50.

Mr. Tristram Beresford, for the respondents, contended that there was evidence upon which the Judge could find that the plaintiffs were ready to deliver, but that delivery was refused by the defendants.

Mr. Justice Horridge said the plaintiffs entered into a contract with the defendants to supply a machine, and defendants promised this bonus of £50 if delivery was made within six weeks. Although the machine was never delivered, the Judge found that if the plaintiffs were ready and willing to deliver it was the same thing as if they had delivered. With that he (his Lordship) could not agree; the plaintiffs could only get their money if they delivered. The only way to get over the difficulty was to show that defendants had requested

them not to deliver by that date or that defendants had in some way broken their contract. Defendants never requested the plaintiffs to delay or prevented delivery, and the plaintiffs could have sent the machine and earned the bonus. They did not do so, and therefore the Court must set aside the judgment awarding them the £50, with costs. The rest of the judgment would stand.

CORRESPONDENCE.

Letters received by us after 5 p.m. on TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

One Solution of the Frequency Problem.

The most obvious method of obtaining two frequencies from one generating unit is of course that suggested by Mr. E. W. Dorey in his letter in your issue of December 2nd, but so far from being "One Solution of *the* Frequency Problem," it is only "One Solution of *one* Frequency Problem," because it is only possible when the non-standard frequency is 100 cycles.

In the scheme suggested in my article, I take advantage of the two independently driven alternators on the double-rotation turbine set to obtain any practical combination of frequencies with minimum capital outlay and also minimum losses.

In propounding my scheme, I sought to avoid odious comparisons between the axial-flow and double-rotation types of turbine, and as both are saleable in the same market, I made, and should have stated, the assumption that as regards efficiency and cost there is nothing to choose between them.

Before considering the various factors in detail, I should like to point out that Mr. Dorey's proposals for running the turbine set as a frequency changer are hardly practicable. The turbine designers would undoubtedly have something to say with regard to the windage losses in a turbine of the impulse type when run without steam, and to uncouple the turbine is a serious matter.

Most station buildings would require alteration to accommodate the long double-alternator set, but the coupler set can be stowed in any odd corner.

Let us compare Mr. Dorey's 100/50-cycle tandem scheme with my proposal of the synchronous coupler set:—

Capital Outlay.—The additional high-speed full-capacity alternator required in Mr. Dorey's scheme would cost nearly 50 per cent. more than the two low-speed alternators of half the power forming the synchronous coupler set.

Losses.—In the one case there are the losses of an additional full-capacity high-speed alternator, whilst in the other there are the losses of two half-capacity low-speed alternators. Assuming normal machines, the losses would be rather less in the low-speed machines. I agree with Mr. Dorey that there are no conversion losses in his scheme, but Mr. Dorey's machine load factor can never exceed 50 per cent.

Obsolete Plant.—Mr. Dorey states that the 100-cycle alternator could be re-wound for 50 cycles. Although the alternator could not be designed to be efficient at both frequencies, I accept this postulate and apply it to my scheme with equal effect. When there is no more need for the special-frquency supply, the obsolete plant will comprise:—

With Mr. Dorey's scheme—

One full-capacity high-speed alternator;

and with my scheme—

The coupler set (only half of which is of non-standard frequency).

Direct Current.—A dynamo can be added to the coupler set, and then the three classes of power can be taken from the set in any proportion. The only feasible method available to Mr. Dorey is to use a rotary converter. This could only be driven from the three-phase alternator, so that he would not obtain the maximum flexibility.

Power Factor.—As stated in my article, by transferring part of the wattless component of the load from the high-speed machine to the low-speed machine, a greater output can be obtained from a standard turbine set. See Mr. Dorey's article, ELEC. REV., November 25th, 1921, p. 723.

Loughborough, Leics. **C. Sutton.**
December 6th, 1921.

The Durability of Lead-covered Cable.

I have read with interest the various letters on the above subject, and quite agree with Mr. Parsons that the main points to be considered are:—

1. Good workmanship, which applies equally to any system.

2. The absolute necessity of seeing that the metal sheathing is properly bonded so as to give perfect continuity to earth.

I venture to say that over 90 per cent. of the failures of lead-covered systems are directly attributable to the fact that no attempt has been made to bond the sheathing, or when an effort has been made it has been done in a slip-shod manner, and the blame is generally put down to faulty material.

To my mind, a lot of these failures would be eliminated if supply engineers and insurance inspectors insisted on proper bonding with fittings specially designed for the purpose, and did not pass installations where the only attempt at bonding was to twist a piece of wire round the sheathing.

In the past there was possibly some excuse for the contractor who thought any sort of bond would do, but now that we are blessed with umpteen systems, there would seem to be no loophole at all for shoddy work. My own experience is, however, to the contrary, as I have still to find the ideal system of fittings, and I think the cable makers would be well advised to give more attention to this, and when designing to try and remember that wiring is generally done from the top of a ladder and not at the bench.

The weak points in the various systems may be briefly enumerated as follows:—

To be in a position to take on a wiring job at short notice, a contractor must of necessity carry a multitude of special fittings, which in some systems means a special box for every position and bonding clips for each size of cable.

One maker attempts to get over this trouble by providing a box with four openings, with the result that when it is used for a tee joint one side is left open. This is not good practice, particularly if the box is used under a floor, and would not, I feel sure, be encouraged by the Fire Insurance Co.

Other makers try to solve the trouble by providing blank covers or boxes and special cutting pliers, but my experience is that these are more often than not missing when wanted, with the result that the wireman makes the best of a bad job by hacking a way in, with the assistance of a hammer and chisel. Only recently I came across a case where the wireman had adopted this method. The job, being duly completed, was tested, and found to be earthed, the fault being found after considerable trouble to be due to the ragged edge of the cover piercing the sheathing.

The question of bonding is not being treated as seriously as it deserves to be, as I find that in some of the later systems efficiency is being sacrificed for so-called simplicity. One firm provides a bonding ring and endeavours to get a satisfactory bond on 2, 3, or 4 cables by means of a centre screw with the wood block as the medium for applying the pressure. What is going to happen when the block shrinks, or when an elbow connection has to be made?

Another source of weakness is tapped holes in soft metal, as the screw threads are so easily stripped should the wireman happen to give the clamping screw an extra turn or two.

From my experience, the only satisfactory method of bonding is to use a separate clamp for each cable; you can then be sure that all are efficiently bonded even when they vary in size. The connectors in general use should also receive attention, as they are not always satisfactory due to missing or faulty screws.

I am also inclined to agree with "Manchester Inspector" that a pure lead sheathing is likely to last longer than an alloyed sheathing, as I have recently heard of two cases where alloyed sheathing has disintegrated. Both these were in coast towns, and the trouble may have been due to atmospheric conditions, but it would be interesting to hear whether any of your readers have experienced similar trouble.

R. Hampson, *Manager,*
The Bolton Electric Co., Ltd.
December 8th, 1921.

With reference to the correspondence in the ELECTRICAL REVIEW recently on lead-covered wires, the Lynton town hall is known to many of your readers, and they probably remember the fine oak work for which that hall is famous. The electric light wiring was done by a firm of South Wales contractors (name unknown to us now) and lead-covered wire was extensively used. Now that wiring is giving trouble, and we have been ordered by the Urban Council to re-wire parts of the hall.

Our men have to-day brought back some samples of the wire that they are removing; everywhere where the lead covering has come in contact with the oak it has undergone some chemical change. I have not the facilities for ascertaining just what has happened, but I am forwarding to you herewith some samples of the wire just as removed from the building, which I hope will be received without further damage, but the white covering is very fragile, and to keep it more or less intact I have wrapped each sample with paper.

Where the lead covering does not come in contact with the oak it seems to have kept fairly well.

As so many country houses have oak work as a feature this change that has occurred in these wires may be of importance in similar positions; if, on examining the wires, you can offer any conclusions it may be a help to those who are using lead coverings in contact with oak beams, &c.

I may add there was no system of bonding. The supply is a.c., single-phase, 100 volts, 100 cycles. The samples are from wires fixed to the open timber work in the roof.

P. T. Kimmins.
Electricity Works, Lynmouth.
December 10th, 1921.

[We shall refer to these interesting samples in a later issue.—EDS. ELEC. REV.]

Business Methods.

For some time past we have been buying in small quantities small reversible ampere-hour meters for use with country-house batteries, these meters being of American manufacture. The importers keep a stock in England, and though the instrument is rather expensive, it does its work, and we get prompt delivery and satisfactory service.

A chance inquiry to one of our big English meter manufacturers recently brought to light the fact that they had started to manufacture a similar meter, and their quotation was 10 per cent. less than for the American instrument. Preferring to do business with English firms where possible, we placed a sample order on their promise of 14 days' delivery, and twice afterwards wrote pointing out the importance of delivery by November 30th, so that it could be fixed by a man who was already on the job. We also had a letter promising delivery by November 30th, and accordingly instructed our man to await the arrival of the meter. To-day (December 7th) we received a letter from the meter manufacturer enclosing a *pro forma* invoice. *Pro forma* invoices are no doubt quite in order between firms which have not done business before, but as four weeks had elapsed since we placed the order, and as delivery was exceptionally urgent, surely this firm could have asked for references or informed us a fortnight ago and asked for a cheque, which we should have been pleased to send. As it is, we have now had to order our man to come home, and a special journey will have to be made to fix this meter at a cost in railway fares alone of £2. (One wonders whether manufacturers realise that contractors pay their men 17s. a day and out allowance.)

Much as we would prefer to do business with English houses, until they wake up to the fact that this treatment is not businesslike, firms like ourselves are being reluctantly forced to place our orders with the more businesslike Yankee.

Matt Jennison,
Managing Director.
Matt Jennison, Ltd.

Grimsby.
December 7th, 1921.

Paper-insulated Wire for A.C. Rewinds.

I should much like to hear the views and experiences of your readers on the results obtained when using paper-insulated conductors in lieu of d.c.c. wires for re-winding a.c. motors. Just at that period subsequent to the armistice, when d.c.c. wire was practically unobtainable, I was called upon to re-wind a 20-h.p. machine removed from a sulphuric-acid plant. I could not obtain the correct gauge of standard d.c.c. copper. Realising that the re-wound motor would have to stand up to heavy duty, accompanied by acid fumes, I decided to experiment with paper-insulated copper of the correct gauge, that being the only type of insulation immediately available. I found it advisable to shellac varnish the paper-insulated conductors before use. Since the completion of the job I have heard nothing in the nature of a complaint or fault though d.c.c. re-winds effected at approximately the same date (nearly two years ago) show signs of failure in the same chemical works. The experience of others would be of much interest to myself.

W. E. Rogers.

London.
December 10th, 1921.

Leaves from an Inspector's Note Book.

This article leaves a nasty taste. "Anode" makes himself the judge of engineers who are very likely earning three times his salary. Perhaps if the "good" engineer had changed jobs and directors with the "bad" one, their qualifications, according to our super-inspector, would have been reversed.

Again, the author appears to think it funny and not dishonourable to alter wrong connections behind his clients' backs, making his opportunity to do so by means of a trick! I was surprised to see that one of "Anode's" connections could be wrong after his ridicule and attempted wit at the expense of another person who also made a mistake. Being "Anode's" own error it would have been less cowardly and more truthful and honest on his part and pacifying to his justly angered client to have admitted the mistake like a man, even to one so lacking in electrical experience as the pork butcher mentioned. I should like to know what would have happened had his client discovered the dirty trick. The pork butcher would probably have treated "Anode" like a pig, and the article which mistakes bad taste for wit and smartness would never have been written!

I should like to talk from the other side of the fence. A firm or corporation has electrical plant and places in charge thereof an experienced engineer. The directors or persons in authority insure this plant. What sometimes happens? A young and bossy inspector earning less than a fitter (see recent advertisement columns) comes along, lords it over a man who was an engineer before the inspector was born, pulls his connections about, puts paper under the brushes, measures the machines as though he was going to market them each a suit of clothes, and very often adds insult to injury by complaining to his company that the engineer does not know his job because the balancer fuses are too heavy or because there are no fuses in the dynamo shunt leads, &c.

A short time ago an inspector reported in writing that a motor of one of our consumers was running too hot. I was called in, and after running the motor at full load for six hours the temperature rise was under 70 degrees F.—and this on a motor which only works normally for 2 or 3 hours a day! This inspector probably had cold hands, as these were his only instruments for a statement which might have been serious to his client.

I could name various other instances to show that even the best of inspectors, like other humans, are sometimes caught napping, but I will content myself by concluding that "Anode" is neither so smart nor so witty as he thinks himself, and in fact his article brands him as a person who tries to shine at the expense of the laymen and other alleged "dull dogs."

A. J. Abraham, M.I.E.E.

Electricity and Tramways Department,
Aberdare,
December 12th, 1921.

A Disputed Meter Reading.

In reply to "Perplexed's" inquiry, I have had similar experience with several a.c. meters of another make, this being due to the meter disk refusing to stop when all load is switched off, owing to the magnetic brake failing to act.

Should this be the trouble, the Corporation load test would fail to show the error. By reinstalling the meter in circuit with a "check" meter on "Perplexed's" premises, or connecting it to the supply on no load for a few days, the approximate amount of error can easily be calculated.

E. T. B.

December 11th, 1921.

The Installation and Use of Electricity in Coal Mines.

I am entirely in agreement with Mr. Travis on the question of installing sufficiently large oil switches, especially below ground. The latest Coal Mines Regulations issued by the Home Office are very stringent with regard to the present-day "Safety First" cry.

It is now possible, however, to obtain an oil switch which is guaranteed flame and explosion proof and which complies with Rules 127 and 132. This is the well-known E.A.C. oil switch with machined flanges and fitted with E.A.C. relief bolts. This switch is theoretically right and has been proved by experiment.

My advice, therefore, to all colliery engineers is to install these switches. On the other hand, E.A.C. relief bolts can be fitted to any make of existing switchgear of suitable design, and having machined flanges. The switchgear then becomes safe. I would ask every colliery engineer: *Is all the apparatus in your mine safe? Does it comply with Rules* 127 *and* 132?.

R. J. Millard.

Nottingham,
December 12th, 1921.

Electric Furnaces in Belfast.—On December 3rd the new steel foundry of Messrs. Sutherland, Ltd., Belfast, was formally opened. The melting is electrical, the furnaces being supplied by a two-phase, three-wire system. The furnace, which can deal with 30 cwt., has a tank furnace body, tilted by means of an electric motor. When the tank is tilted the steel runs into a ladle, which is conveyed to any part of the foundry by an electrical overhead travelling crane.

After the opening ceremony, Mr. T. D. Robertson, of Electro Metals, Ltd., who built the furnace, read a very interesting paper on "Electric Steel." He said it was interesting to note that this was the first attempt to make steel in Belfast in commercial quantities.

Irish Water Power.—At a meeting in Dublin of the Institution of Civil Engineers (Ireland), Sir John P. Griffith, Chairman of the Board of Trade Sub-Committee on the Water Power Resources of Ireland, said that Ireland had been specially favoured by investigations of this kind. He did not want to belittle the country's resources of coal and peat, but it should be remembered that these were exhaustible sources of power, while water was perennial, and would last as long as solar influence evaporated water from the Atlantic. The keynote of the Sub-Committee's report was the storage of water. They must be prepared to sacrifice some interests to have proper storage, but he knew of hardly any country that was so favoured with the means of obtaining storage of water as Ireland. The Sub-Committee had only dealt with the large rivers, and he expressed his conviction that what it had done could be done for every reasonably-sized river in Ireland.

BUSINESS NOTES.

The "Electrical Review" Issue for December 30th.—We desire to direct the attention of our advertisers and readers to the announcement appearing in our advertisement pages to-day respecting the dates for sending in copy for our issue of December 30th. All editorial matter must reach us much earlier than usual, as the greater part of the Review will have to be "made up" before the Christmas Holidays begin.

Bankruptcy Proceedings.—A. V. Fowler, electrical engineer, Seacliffe, Fitzroy Avenue, Kingsgate, Kent.—Receiving order made December 10th on creditor's petition.

William Bennett, residing at 1, Richardson Street, and carrying on business as an electrical contractor at Sitwell Street, Derby.—A meeting of the creditors was held at the offices of the Official Receiver at Nottingham, on Wednesday. The statement of affairs showed liabilities £129, and a deficiency of £99. Debtor, according to his statement of affairs, commenced business as an electrician and electrical contractor in Sitwell Street, Derby, in October, 1919, with a capital of £200, borrowed from a friend, which had since been repaid. He kept no books of account, he had no banking account, and he stated that for the first two years the net profits of the business did not amount to more bentures for £2,000 and rank as an ordinary creditor if a loss. The unsecured liabilities were all for trade and domestic debts. He attributes his insolvency to depression in trade, keen competition, and ill health. There being no quorum at the meeting, the matter was left in the hands of the Official Receiver.

James Joseph Smith, electrical engineer, trading at 1, Central Street, E.C., under the style of J. Smith & Son.—Creditors met last week at the London Bankruptcy Court before Mr. Warren, Official Receiver. Tue receiving order was made on November 24th upon the petition of the Sloan Electrical Co., Ltd. The debtor has stated that he commenced business as above in March, 1919, with £70 capital; it was successful during the first year, but the recent trouble in the coal and engineering industries practically killed it, and he had never been able to recover a sound position. The liabilities were estimated at £300, and in the absence of assets the case was left with the Official Receiver to be wound up in bankruptcy.

J. G. Williams, electrical engineer, 4, Blaennart Street, Duffryn, Cymmer, Port Talbot.—First meeting, December 21st, at the Official Receiver's Offices, Government Buildings, St. Mary Street, Swansea; public examination, January 17th, at the Town Hall, Neath.

W. Hill, "seedsman and electrician," 3a, Leigh Road, Leigh.—Receiving order made December 9th on debtor's own petition.

H. E. Carr, electrical engineer, Carlisle Street, Goole.—First and final dividend of 5s. 5½d. in the £, payable at Carlisle Chambers, Goole.

Company Liquidations.—The Phonopore Construction Co., Ltd., the Phonopore Works, Southall, Middlesex.—The first meeting of the creditors of the above was held on December 5th at 29, Russell Square, London, W.C.1. The Official Receiver reported that the company seemed to have been incorporated on March 29th, 1916, and was formed with the object of carrying on business as manufacturers of telephone instruments. The company carried on business until June, 1917, when its works were taken over by the War Office, and it then practically ceased to do any trade until January, 1919, when the War Office gave back possession of the premises. Later £1,500 was awarded in respect of compensation, and he (the Official Receiver) understood there was a question of a further payment due to the company. A representative on behalf of the Crown said the War Office had three claims against the company, one of which was for £20,750. Mr. F. R. W. Robinson said the company still had a claim against the Crown for over £3,000, of which £700 was in respect of the balance of the award granted by the Royal Commission, and the remainder was for re-instatement. The Official Receiver, continuing, said debentures were issued, the holders of which were Mr. F. R. W. Robinson, Mrs. Robinson (his wife), and Mr. F. R. H. Robinson (son). Mr. F. R. W. Robinson was appointed Receiver by Mrs. Robinson under her first debenture, and he was now in possession of the company's assets. The statement of affairs had not been lodged, but the liabilities were stated to amount to £2,500. The company's failure was stated to have been due to the occupation by the War Department of the company's premises, loss of goodwill, and general depression in trade. Asked if he had any proposal to make to the creditors on behalf of the company, Mr. Robinson said he was in touch with several people, and he was doing his best. He was willing to give up his own debentures for £2,000 and rank as an ordinary creditor if a working agreement was arrived at. The creditors decided that no application be made to the Court to appoint a liquidator other than the Official Receiver. A committee of inspection was nominated.

Associated Trading & Engineering Co., Ltd.—A petition for the winding up of this company has been presented by Messrs. H. Barnett & Co., Ltd., of 8, Vine Street, Minories, E., and will be heard in London on December 20th.

Leeds Alliance Electrical Manufacturing Co., Ltd.—Meeting of members is called for January 17th at 1, Albion Street, Leeds, to hear an account of the winding-up from the Liquidator, Mr. S. S. Tadman.

Egyptian Power & Nitrogen Syndicate, Ltd.—Winding up voluntarily. Liquidator, Mr. J. S. Mallam, 1, Queen Victoria Street, E.C. Meeting of creditors December 28th, at 1, Queen Victoria Street, E.C.

Ilford Dry Battery Co., Ltd.—Winding up voluntarily, as the company cannot, by reason of its liabilities, continue the business. Liquidator, Mr. G. W. Roberts, 2, Guildhall Chambers, E.C. Meeting of creditors called for December 19th at the offices of the Liquidator. Particulars of claims must be sent to the Liquidator by January 31st.

Power Gas Economy, Ltd.—Particulars of claims should be sent to Messrs. Thomson, McLintock & Co., 216, West George Street, Glasgow, by December 31st. A second and final dividend will be paid immediately on the expiry of the above date. Liquidator Mr. J. Duncan.

Argentine Electricity Co., Ltd.—Meeting called for January 16th at 62, New Broad Street, E.C., to hear an account of the winding up from the liquidator, Mr. T. S. Hamilton.

Dissolutions of Partnership.—H. & G. Ashworth, electrical engineers, 17, Mayville Road, Brierfield, and 33, Garrick Street, Nelson, Lancs.—Mr. H. Ashworth and Mr. G. Ashworth have dissolved partnership. The former will attend to debts.

J. W. Hargreaves & Co., electrical engineers, 104, Park Lane, Leeds.—Mr. J. W. Hargreaves and Mr. R. D. Syson have dissolved partnership. Debts will be attended to by Mr. Hargreaves, who will continue the business under his own name.

Trade Announcements.—Messrs. J. H. Hawkins and C. M. Hallahan have opened an electrical department in connection with their business at 58, High Street, Aylesbury.

Mr. Reginald Cox, who has been for many years connected with the English Electric & Siemens Supplies, Ltd., and their predecessors, has resigned his position in order to undertake the management of the London office of Tramway Supplies, Ltd. (of Leeds), at 93, Cannon Street, E.C.4, which office is being opened to deal with business in the south for home and export. Telephone No., "City 3014"; telegrams: "Tramsuplim, Cannon, London." In addition to tramway requirements, Mr. Cox will handle the T.S. oil switch equipment, distribution panels, underground cable boxes, and other manufactures.

The Yorkshire Electric Power Co.'s head office has been removed to 36 & 37, Park Place, Leeds. Telephone: "24,578 Leeds"; telegrams: "Yepower," Leeds.

The business of Messrs. Sutcliffe Bros., 90 & 91, Queen Street, E.C.4, has been taken over by Messrs. E. G. Hoare and L. E. Milburn as from the 1st inst It will be carried on exactly as before and under the same style.

Messrs. W. H. Allen, Sons & Co., Ltd., of Bedford, have appointed Mr. Harry Astbury, A.M.I.M.E., of 159, Gt. Charles Street, Birmingham, as their representative for the Birmingham district.

Messrs. Hubber & Son announce that the business of the late Mr. Frank Hubber, electrical engineer, of 85 and 86, South Street, Exeter, will be continued by them, with Mr. Walter H. Hubber as manager.

Messrs. Higgs Bros., of Sand Pits, Birmingham, are opening a branch at 3, York Street, Manchester, to deal with all sales in Lancashire and Cheshire.

Mr. W. Dolan, having started in business as an electrical wiring contractor, at 214, Somers Road, Southsea, desires catalogues of lighting, heating, telephone and other accessories and fittings.

Messrs. George Boor & Co. have removed to 65, Fenchurch Street, London, E.C.3. Telephone No.: Avenue 5781.

Catalogues and Lists.—Messrs. Nalder Bros. & Thompson, Ltd., 97a, Dalston Lane, E.8.—An illustrated booklet showing construction, connections, &c., of ammeters, voltmeters, power-factor meters, synchroscopes, and other power-station instruments, testing sets, &c.

Messrs. Bates & Nortcliffe, Ltd., Perseverance Works, Brighouse, Yorks.—A price list of mild steel wire of various gauges, shapes, and finishes.

Lep Transport & Depository, Ltd., Castle Street, Long Acre, W.C.2.—A "manifesto" describing the various services which the firm provides, including motor, railway and sea transport, storage, &c.

Scaldis Works (A. Bruynooghe), 11, Balham Grove, S.W.12.—A price list of d.c. and a.c. motors.

Societe Industrielle d'Electricite (France), 23, Queen Anne's Gate, S.W.1.—A price list of "Eternos," "Radius," and "Perfectos" safety cartridge fuses.

The Y-Switchgear Co., Temple Courts, Temple Row, Birmingham.—Publication No. 101/1, giving illustrations, details, and prices of controller-type motor-control oil switches.

Messrs. Ruston & Hornsby, Ltd., Lincoln.—A booklet setting forth the advantages of oil fuel.

The Mitchell Conveyor & Transporter Co., Ltd., Atlantic House, Holborn Viaduct, E.C.1.—An illustrated brochure giving many particulars regarding the cost and working of locomotive coal- and ash-handling plants.

Messrs. Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester.—Circular announcing reduced prices of "Izolex" fuse units and boards. Illustrated.

Metropolitan-Vickers Electrical Co., Ltd., 20, Brazennose Street, Manchester.—A booklet containing illustrations and "revised" versions of nursery rhymes, advertising "Cosmos" lamps. The booklet also includes particulars of a colouring competition for children.

The Cable Accessories Co., Ltd., Britannia Works, Tipton, Staffs.—An illustrated and priced catalogue of "Revo" switch- and fuse-gear, sealing chambers, &c.

Calendars and Almanacs.—Messrs. Mawdsley's, Ltd., of Dursley, have issued a calendar for 1922, with a set of small monthly slips placed beneath a picture well executed in colour of "A Refreshing Interval" (Val Davis)—a lady artist enjoying a cup of tea.

Messrs. Aiton & Co., Ltd., of Derby, have issued a hanging wall calendar, the pictorial feature of which is a beautiful collotype reproduction of E. Henry Holder's painting, "The River Yealm, Devonshire."

A wall sheet calendar with monthly date slips for 1922 has been received from the National Engineering Supply Co., of Cardiff.

Composition.—K. H. Kerr & Co., electrical accessories manufacturers, Barr Hill Works, Dalbeattie.—Messrs. W. & W. B. Galbraith, chartered accountants, 87, St. Vincent Street, Glasgow, state that the committee of creditors has held various meetings. They have been instructed to pay the creditors as an instalment towards the composition of 10s. in the £, one-half, or 5s. per £, the balance to be paid by the debtor in six months or thereby.

Our Foreign Trade.—November figures:—The following were the values of imports and exports of electrical goods and machinery during November, 1921:—

	Nov. 1921.	Inc. or dec.	11 months, 1921. Inc. or dec.
Imports.—	£	£	£
Electrical goods and apparatus ...	132,836	– 110,472	+ 263,093
Machinery	648,144	– 960,274	– 7,970,130
Exports.—			
Electrical goods and apparatus ...	790,895	– 427,203	+ 2,050,560
Machinery	6,023,903	– 1,764,250	+ 13,088,414
Re-exports.—			
Electrical goods and apparatus ...	11,315	– 3,600	+ 69,343
Machinery	97,230	– 67,510	– 389,854

Engineering Trade Ballot.—The Executive Council of the Amalgamated Engineering Union, in an official statement, strongly advises members to vote for the agreement on freedom of management and overtime, recently provisionally arrived at with the Engineering and the National Employers' Federations. The continuance of the negotiations on the question of machines, apprentices, and payment for holidays is contingent on acceptance of the agreement. "Therefore," the Executive Council say in conclusion, "it is imperative that the agreement should be accepted, and thus enable negotiations on these important matters to be proceeded with." The ballot on the question will be taken in the next week, and the result will not be known until early in the New Year.

Mr. J. T. Brownlie, President of the Amalgamated Engineering Union, in his monthly report, says the membership of the Union, which stood at 460,000 at the beginning of the year, declined to 430,000 at the beginning of December. Nearly 26 per cent. of the members of the union are unemployed.—*Westminster Gazette.*

Electrical Supplies in South Africa.—According to the *South African Mining and Engineering Journal*, of November 19th, the improvement in electrical goods noted during the preceding month or six weeks continued, and dealers appeared to be fairly busy as compared with recent months. Stocks held were plentiful, and continued to arrive in fair quantities. "Prices, merchants state, appear at present to be balancing themselves both at home and in Germany and Holland. America, as previously stated, is very seriously handicapped on account of the exchange. Although there are no big contracts going at present, there is a fair daily amount of house wiring."

For Sale.—West Hartlepool Corporation Electricity Department has for disposal a Tudor storage battery, capacity 2,590 amp.-hours on a 10-hours' rating. (See our advertisement pages to-day.)

Book Notices.—"The Electro-metallurgy of Steel," by C. C. Sow, p.p xvi+351, 132 figs. London: Constable & Co., Ltd. Price 27s. 6d.

"Inaugural Address to the Institution of Electrical Engineers," by J. S. Highfield. (Reprinted from the *Journal*). (9 pp.). London: The Institution.

"The Book of the Ford Van," by R. T. Nicholson; second (revised) edition. London: Temple Press, Ltd. Price 3s. net.—The second edition of this work has been completely revised and enlarged. It deals in a comprehensive manner with the care and maintenance of the "Ford" van, and gives some idea of its commercial possibilities. The new electrical outfit is described, and it is noticed that the magneto is no longer the source of lighting current; it is possible to use the battery for starting, if desired.

The *Decimal Educator* for December contains a report of the annual meeting of the Decimal Association, at which it was resolved to concentrate attention in the first instance on the reform of the units of weight, and to support Mr. Harry Allcock's proposal for an increase in the value of the penny to one-tenth of a shilling. Articles in support of these policies, by Mr. E. C. Barton and Mr. Allcock, and on the progress of the Metric Bill in the U.S. Senate, also appear. The journal is published by the Decimal Association, price 6d.

Insulating Tubes in Germany.—The Syndicate of Insulating Tube Works of Dortmund, announces an increase in prices of 20 per cent. owing to the greater cost of raw materials and the rise in wages. It is stated that a large quantity of raw materials has got into the possession of speculative dealers, some of whom have been reported to the public authorities for profiteering, and that the actual producers have assisted the practice.

Belgian Tramway Concessions in Russia.—According to reports from Moscow and Riga, the Soviet Government is in negotiation with the Berlin A.E.G., with a view to the transfer to the latter of the concessions for the working of tramways, formerly in Belgian ownership, in various towns in Russia. The Government is said to demand in return, a share of 50 per cent. of the net profits, and the company would have to undertake to feed the workmen and staff.

Czecho-Slovakia.—At the last meeting of the directorates of the Bohemian-Moravian Machine Works and of the Elektricitätswerke Aktien Gesellschaft (formerly Kolben & Co.) it was decided to amalgamate the two concerns from January 1st next. The share capital of the Bohemian company is to be raised from 6,000,000 to 8,000,000 kronen.

The Japanese Delegation.—The delegation of 23 Japanese business men, who, together with a secretariat of 28, arrive in this country from the U.S.A. on Monday next, will have conferences with a large number of financial, commercial, shipping, and other authorities in London. They will also study traffic control, the underground system, and many other matters here, and will visit the important provincial centres in January, leaving for the Continent on January 21st. A programme of the visit appeared in *The Times* on Tuesday.

Chinese Notes.—Four electrical undertakings have recently been registered with the Chinese Ministry of Agriculture and Commerce, namely: the Shou-shing Telephone Co., Shou-shing, Chekiang; the Jui-An Electric Light Plant; Sui-an, Chekiang; the Chowshan Electric Co., Chowshan, Chekiang; and the Sun Fong Electric Co., Kiangsu. Other electric companies that have been organised are the Yau Tai Electric Light Co., at Tai Hsin, Kiangsu, and the Sing Yang Electric Light Co., of Sing Yang, Honan. Chen Yi-hee, president and organiser of the Sunning Railway, expects to organise a company with 2,000,000 dols. capital to develop a water-power project near the town of Sunning. As soon as the necessary capital has been fully subscribed it is planned that contracts for the equipment will be placed immediately. —*Far Eastern Review.*

New French Companies.—The Etablissements Paul Cadot has been formed at Paris (108, Boulevard Haussmann), with a capital of 2,000,000 fr., with the object of manufacturing accumulators and electrical apparatus for motor-cars.

A French Failure.—The failure is announced of the Société Industrielle de Télégraphie Sans Fil et d'Electricité, 200,000 fr. capital, of 18, Rue Duppot, Paris. Liquidator, M. Gaubert, 1, Rue Dante, Paris.

Lead.—Messrs. James Forster & Co., reporting on December 10th, say:—"Trade demand continues very slack, but, slack as it is, it is well to remember that the consumption for sheet and pipe lead continues steadily round about 5,000 tons per month, and that for white lead probably about 3,000 tons monthly, making 8,000 tons, added to which is the electrical trade, which also at present is very slack. Against such figures we had 3,015 tons left for home absorption in October, and not much more for November, so the complete disappearance of all public stocks is not to be wondered at! France, Germany, Holland, and South America continue to buy, and English manufacturers are sold out for some time ahead. The Board of Trade returns for November are:—Imports, 8,852 tons; exports, 2,843 tons; leaving for home absorption, 6,009 tons."

The Russo-German Reconstruction Scheme.—In further reference to the A.E.G. Russian scheme, to which we refer in our leading columns to-day, the Berlin correspondent of the *Manchester Guardian Commercial* states that the driving force for the resumption of Russo-German trade relations and for the handling of the Russian problem on a generous scale is Herr Deutsch, the general director of the Allgemeine Electricitats Gesellschaft, "who is of opinion that the trade opportunities offered by Russia are sufficient to give full occupation for a number of years to the industries of all countries. He does not see the need for acute competition, and believes that international co-operation is the solution to the problem. He has, therefore, worked out a plan, which he submitted, during a recent stay in London, to a number of leading English personalities, who were apparently quite enthusiastic about it. Roughly speaking, Deutsch considers that America would grant credit and supply raw materials; Great Britain would see to transport, grant credits, and also send manufactures; while Germany would act as manufacturer. All orders from Russia would go straight to this international organisation, and be executed at a certain fixed price, which could be somewhere between the British and German cost of production. Profits on German orders would compensate losses on British supplies." Sir Peter Rylands is stated to consider that, while some such scheme is desirable in the general interest of European trade, it should be carried out as part of the Reparations scheme, without aid from America, and under Allied supervision.

In an interview also published in the *Manchester Guardian Commercial*, Mr. Krassin, discussing the German proposals for developments in Russia, said that a trade arrangement of some sort was just as essential to Russia as it was vital to Germany; the 150 million peasants in Russia were in urgent need of the thousand and one things which they had been compelled to do without practically since the war started. Mr. Krassin also agreed that the prospect of obtaining necessary commodities and utensils would spur the average Russian peasant to increased production, and in this connection he gave his opinion that guarantees on Russia's part could safely be confined to repayment by means of surplus grain, &c., as rouble notes would be useless beyond the borders of Russia. He had discussed the formation of some such similar scheme with Herr Deutsch, of the Allgemeine Electricitats Gesellschaft, and with many other business men on the Continent, who fully recognise the fact that the present state of affairs in Europe is bound to grow still worse unless a sane attempt can be made to bring Russia once again within the wheels of international trade.

Bennis Contracts.—A large number of orders have been recently received by Messrs. E. Bennis & Co., Ltd., for their stokers and compressed air furnaces for Lancashire boilers, chain grate stokers for water-tube boilers, and mechanical coal and ash handling machinery. The list of contracts before us includes equipment for collieries, mills, iron and steel works, and the Ashton-under-Lyne Electricity Works, the last-named order being for four chain grate stokers for Thompson water-tube boilers.

£2,000 per Annum.—It appears that employers experience difficulty in finding men qualified to occupy positions where their services will be worth £2,000 per annum to the businesses in which they are engaged. It seems to us that it is unreasonable to expect to find strong swimmers among those who paddle with the crowd on the water's edge. What bring out the strength of a man's character are opportunity and responsibility. Cadets are not expected to conduct campaigns, they must first serve as captains and colonels. Administrative ability needs cultivation and experience. Is it not time that some employers were bluntly told that they are themselves to blame for lack of promising material among their people? If managers and sub-managers are allowed to crush initiative, frown on ambition and penalise enterprise, employers must not expect to find potential £2,000 men in their employ. Intelligent young men do not stop with such firms. Incidentally, some readers might be glad to know where these employers conceal themselves when the £1,850 man is looking for a rise!—*The Times Trade Supplement.*

Wages in the Electricity Supply Industry.—At a meeting of E.T.U. shop stewards of the No. 10 (Greater London) Area, on December 5th, it was decided to call for the setting aside of the national agreement as to wage reductions arrived at by the N.J.I.C. for the industry, so far as No. 10 Area is concerned. The ground upon which this was demanded was that wages variations were already provided for in the special agreement for the No. 10 Area. It was declared at the meeting that any further wage reductions would be strenuously opposed.

A Ten per Cent. Paper Dividend.—The Rhenish-Westphalian Electricity Works Co., of Essen, which is largely a pit bank generating undertaking, has just declared a dividend at the rate of 10 per cent. for 1920-21. The chairman stated that a 10 per cent. dividend in paper was 0.2 per cent. in gold.

Price Reductions.—Messrs. Donovan & Co., of Birmingham, announce that though the recent award reducing wages has not yet had full effect, they are increasing discounts on "Safuse" and "Donlok" gear by 20 per cent. as from December 1st.

New Metropolitan-Vickers Showroom.—The Metropolitan-Vickers Electrical Co., Ltd., has just opened a showroom at No. 7, Saville Row, Newcastle-upon-Tyne. The new premises are most conveniently situated, being in the centre of the business section of the city. The showroom, elegantly fitted from the firm's own designs, is divided into three sections, representative, respectively, of the Adam, Jacobean, and Georgian styles of decoration, and in each case the electric-light fittings, pendants, shades, &c., are all in harmony with the surroundings. The different styles of furnishing are found very advantageous in judging the exact effect of the fitting in varied surroundings. Beyond the sections devoted mainly to lighting fittings, is an industrial department. Here are shown many types of ironclad switchgear, cables, samples of conduit, and a large display of all sorts of bell pushes, switches, indicators, &c. The firm's "Cosmos" specialities are also displayed. Exhibitions of electric cooking are to be frequently given; an electrically-heated water supply and electric irons add to the general interest of the display.

Unemployment.—The latest statistics of unemployment issued by the Ministry of Labour show that the total number of unemployed persons on December 2nd was 1,835,200, an increase of about 2,000 on the week. Short-time workers numbered 265,500 on November 25th. Relief schemes estimated to employ about 41,000 men for periods averaging five months have been approved by the Unemployment Grants Committee.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trade marks in respect of goods and productions connected with the electrical trades and industries:—

Crypto. No. 408,423. Class 6. Induction motors, rotary transformers. October 5th, 1920. No. 419,518. Class 8. Fitted electrical switchboards and alternating-current starting apparatus. October 13th, 1921.—The Crypto Electrical Co., Ltd., Acton Lane, Willesden Junction, N.W.

Ebacol. No. 418,882. Class 6. Mechanical and electrical machinery of all kinds.—Edmiston Brown & Co., Ltd., 219, St. Vincent Street, Glasgow. September 27th, 1921.

Secura. No. 418,644. Class 50. Electrical insulating materials, sleevings, and coverings made from a textile fabric impregnated with an insulating varnish.—Edward P. Brasse, Culvert Works, Culvert Road, Tottenham, N. September 17th, 1921.

Lew. No. 418,872. Class 5. Metallic wires. No. 418,873. Class 8. Electric light flexibles and telephone flexibles composed of two or more wires insulated with india-rubber with an outer covering of textile material. No. 418,874. Class 32. Wires covered with silk. No. 418,875. Class 40. Wires covered with india-rubber. No. 418,878. Class 50. Impregnated electrical insulating tape.—The London Electric Wire Co. & Smiths, Ltd., 7, Playhouse Yard, Golden Lane, London, E.C. September 26th, 1921.

Aron. No. 415,009. Class 8. Electricity meters.—Aron Electricity Meter, Ltd., 60, Salusbury Road, London, N.W. May 9th, 1921.

MV. (lettering and design). No. 418,908. Class 50. Electric insulators, electric insulating materials, and electric insulating preparations.—Metropolitan-Vickers Electrical Co., Ltd., 4, Central Buildings, Westminster, S.W. September 27th, 1921.

Milestone. No. 416,959. Class 8. Voltmeters.—H. Gordon, Ltd., 8, City Road, London, E.C. July 14th, 1921.

Sunco (lettering and design). No. 419,647. Class 18. Electric fires, being heating apparatus for buildings.—The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, London, W.C. October 18th, 1921.

German Porcelain Insulators.—The prices of high-pressure porcelain insulators were increased in Germany by 20 per cent. at the beginning of this month.

Action by London Members of the E.T.U.—In the Electrical Review for November 18th (p. 675), we published the chief reasons of the Executive of the Electrical Trades Union for suspending the London District Committee. It is stated in the *Electron* for December that in view of the action of the executive certain London members applied to the High Court to restrain the executive from carrying their resolution into effect. The application was heard by Mr. Justice Astbury, who ruled that the cause did not lie. In giving his ruling, the judge pointed out that, under the constitution, the executive had no power to suspend a district committee, but that the rules provided that such committee should consist of one delegate from each branch in the district, which branches alone had the power to suspend their elected delegates. A district committee for London would have to consist of 99 members—one from each of the 99 affiliated branches. The *Electron* adds: "Steps were accordingly taken to form such committee, and on Thursday, November 17th, the full district committee, constituted in accordance with rule, met for the first time. It included, naturally, the members "suspended" by the E.C., whose branches were satisfied with their representatives, and who will do their own "suspending" if and when they become dissatisfied.

LIGHTING AND POWER NOTES.

Aberdeen.—MINERS' STRIKE.—The Electricity Committee recently sought compensation for an alleged loss due to the action of the Coal Controller during the miners' strike in holding up supplies of coal to the electricity works. The War Compensation Court decided, however, that the Corporation had suffered no loss which could properly be made up from public funds.

Banff.—PROPOSED ELECTRICITY SCHEME.—A report has been prepared by Mr. Bell, of Aberdeen, upon a scheme of electricity supply for Banff and Macduff. The estimated cost is £20,000.

Bangor.—BULK SUPPLY.—On December 7th the City Council approved a recommendation of the Electricity Committee to conclude an agreement with the North Wales Power Co. for a bulk supply of electricity. The sum of £9,000 is to be borrowed to cover the cost of plant, cables, &c.

At the same meeting it was decided to apply for sanction to borrow £2,000, being the prospective expenditure upon mains, services and meters during the ensuing two years.

Barrow.—PROPOSED PRICE INCREASE.—A proposal to increase the price of electricity was brought before the Council on December 5th. It was stated that a loss of £10,000 had been incurred by the undertaking during the first half of the present working year. The Council, however, referred the proposal back to committee.

Barry.—GAS *v.* ELECTRICITY.—A crowded meeting under the auspices of the Local Ratepayers' and Property Owners' Association was held at Barry on December 7th to discuss the proposal of the Urban District Council to expend £125,000 on the extension and improvement of the gas works. At the invitation of the Association, Mr. W. A. Chamen, general manager of the South Wales Electrical Power Co., Ltd., addressed the meeting. He stated that £60,000 would be sufficient to give a fair supply of electricity to the town, and a cable could be laid from Barry to Llandaff for an additional £25,000. He contended that electric lighting would be considerably cheaper for the town than gas. A resolution was passed unanimously calling upon the Council to stay its hand before spending such a large sum of money on the gas undertaking, pending advice upon estimates for electric lighting. Mr. C. B. Griffiths, chairman of the Council's Gas and Water Committee, challenged Mr. Chamen to meet him to debate the merits of gas *versus* electricity.

Bootle.—PROPOSED TRANSFER.—Proposals are under consideration for the transfer of the Corporation's electricity undertaking to the Liverpool Corporation.

Brackley.—PROPOSED ELECTRICITY SUPPLY.—The Town Council has decided to call a town meeting to consider the question of an electricity works for the town. The promoter of a scheme at Woodstock has offered to carry out a similar scheme at Brackley if a capital of between £4,000 and £5,000 is raised locally.

Burnham (Berks).—ELECTRICITY SUPPLY.—The Slough and Datchet Electric Light Co. has informed the Council that it cannot see its way clear to extend its cables to Burnham. The Council has decided to write to the Electricity Commissioners for advice as to the action to be taken to secure revocation of the company's powers of supply in this district.

Chester.—EXTENSION OF SUPPLY AREA.—The Corporation is applying to the Minister of Transport for a special order to extend the area of supply to include the urban district of Hoole and certain portions of the rural district of Chester.

Continental.—FRANCE.—A concession has been granted to the Société Normande d'Electricité to supply electricity for public purposes and to private consumers. The company's network (30,000/5,000 volts) comprises the communes of Mailleraye and Hearteauville in the Seine Inférieure department and sundry communes in the Quillebœuf district of the Département de l'Eure.

A 120,000-kW generating station is shortly to be set up in the Sarre coalfields. The Administration Domaniale des Mines has engaged the Société Générale d'Entreprise, 56, Faubourg St. Honoré, Paris, as consulting engineers, on whom will fall the duty of choosing the *concessionaire* after examination of the schemes submitted.

Croydon.—DOMESTIC SUPPLY EXPERIMENT.—As an experiment, the Electricity Committee has decided to supply electricity for both lighting and cooking through one meter to the houses on the Norbury estate, at a weekly charge of 1s. 6d. Energy used in excess of 42 units per annum will be charged for at the rate of 2½d. per unit.

Darlington.—YEAR'S WORKING.—The net profit of the Corporation electricity department for the year ended March last amounted to £579, as against £5,365 in the previous year.

Dover.—LOAN SANCTIONED.—The Town Council has received sanction to a loan of £8,000 for the extension of the electricity supply to St. Margarets, and for mains and transformers.

Dublin.—ELECTRICITY SUPPLY EXTENSIONS.—The Corporation is being urged to extend the electric lighting system to the Inchicore district.

Dumfries.—PRICE REVISION.—The Electricity Supply Co., Ltd., has applied for permission to charge 1s. per unit, with a minimum payment of 15s., for each of the winter quarters, and 10s. for the summer quarters.

Edinburgh.—YEAR'S WORKING.—The accounts of the electricity undertakings (Engineer: Mr. F. A. Newington), for the year ended May 15th last, record, as regards the Edinburgh undertaking, a total revenue of £314,669, as compared with £234,247 in the preceding year. Working expenses amounted to £241,054, as against £162,020, leaving a gross profit of £73,615 (£72,227). After payment of capital charges, &c., a deficit of £963 was the net result; in 1919-20 a net profit of £10,551 was made. The total number of units sold rose from 24,401,273 to 29,627,259, of which 3,340,464 units was supplied in bulk to Leith.

The Leith accounts show a total revenue of £79,457 and working expenses £77,237, leaving a gross profit of £2,220. The net result was, with a credit balance of £6,175 brought forward, a deficit of £11,210. The number of units generated was 4,414,045.

Feltham.—ORDER REVOKED.—The Ministry of Transport has revoked the Electric Lighting Order of 1914.

Fraserburgh.—ELECTRICITY SCHEME.—The Town Council has under consideration a proposal for the installation of electric lighting in the town. It is estimated that the scheme would cost £8,000 and provide work for 300 men.

Halifax.—YEAR'S WORKING.—The accounts of the Corporation Electricity Department (Engineer: Mr. W. M. Rogerson, M.I.E.E.) for the year ended March 31st last, show a total income of £182,998, as compared with £137,832 in 1919-20. Working expenses amounted to £126,983, as against £80,752 in the previous year, leaving a gross surplus of £56,015 (£57,080). After the payment of capital charges the net result was a profit of £20,124, as compared with £23,997 in the preceding year. The total number of units sold increased from 16,161,399 to 18,521,577, and the maximum demand from 7,760 to 8,790 kW.

India.—KALLAR FALLS SCHEME.—A conference was held last month to consider a scheme for utilising the Kallar Falls for the generation and supply of electricity to the whole of Travancore. It was decided to proceed with the scheme and to seek the permission of the Madras Government to erect a power house in a British District.

THE MULSHI SCHEME.—A statement regarding the acquisition of land for the formation of a lake in connection with the Mulshi hydro-electric scheme, was recently issued by the Tata Power Co., Ltd. This refutes exaggerated statements as to the area to be submerged, and states that liberal compensation has been made to the evicted landowners or tenants. The land will be gradually submerged, and the bulk of the area will be untouched for five years; in the meantime the tenants are being allowed to raise crops free of charge.

THE PARBATI RIVER PROJECT.—This scheme was described in a recent issue of the *Indian Textile Journal*. It is planned to utilise a fall of about 285 ft. in the Parbati River. The first part of the installation will consist of two horizontal-shaft turbines direct-coupled to 3-phase, 5,000-V, 600-kW alternators. The power will be stepped up to 30,000 V for transmission over a distance of 10 miles to Lashkar, where a distributing station is to be erected. Other schemes mentioned are the Sindh River project, developing from 50,000 to 70,000 h.p. under a head of 780 ft., and the Kuno River scheme, by which it is estimated 4,375 water h.p. can be developed, utilising a head of 55 ft.

Keighley.—LOAN.—The Electricity Committee has recommended that application be made to the Electricity Commissioners for sanction to borrow £10,000 for the erection of an overhead transmission line from Eastburn to Skipton, and for the necessary control gear, &c.

Lancaster.—LOAN SANCTIONED.—The Town Council has received sanction to borrow £7,600 in respect of the proposed extension at the electricity works.

Langholm.—ELECTRICITY SUPPLY.—The Town Council has requested the Lighting Committee to submit a report on a scheme for electricity supply to the Burgh.

Lincoln.—LOAN.—The City Council has decided to apply for sanction to borrow £132,229 in respect of St. Swithin's power station.

Maidstone.—YEAR'S WORKING.—We have received from the Borough Electrical Engineer (Mr. E. E. Hoadley, M.I.E.E.) a copy of the Electricity Department's report and accounts for the year ended March 31st last. The total income was £58,402, as compared with £43,935 in 1919-20. Working expenses totalled £46,374, as against £32,263, leaving a gross profit of £12,028 (£11,672). The net result was a loss of £526; in the preceding year there was a profit of £1,486. The total number of units sold was 4,993,740, an increase of 392,861. The report gives details of a number of large extensions in a.c. supply during the year, and attributes the loss incurred to trade depression and the miners' strike.

LOAN SANCTIONED.—The Town Council has received sanction to a loan of £5,134 for plant for the electricity works.

Mumbles (Glamorgan).—Applications for Electricity.—At a recent meeting of the Swansea Electricity Committee it was stated that a number of residents at Mumbles had asked for a supply of electricity. The engineer said that the cost of providing this would be about £15,000, and at least 500 consumers would be necessary to make the scheme remunerative. A further report was asked for.

Newark.—Electricity Supply.—The Lincoln City Council has decided to supply the Corporation with electricity on terms and conditions to be arranged, subject to the Corporation agreeing to provide and fix at its own expense the necessary transmission lines from St. Swithin's power station to Newark.

Rathmines (Co. Dublin).—New Plant.—As the plant at present installed cannot now meet the demand for electricity, the Urban Council has decided to install a 750-kW turbo-generator at a cost of about £30,000. An amendment, seeking to defer the matter for six months, was lost.

Salford.—Erection of New Station Approved.—On December 7th the Council approved the recommendation of the Electricity Committee to proceed at once to prepare drawings and estimates for the erection of the new station at Agecroft. The chairman of the committee pointed out that the estimated cost of the station was £847,000, whereas a year ago the figure was put at £1,189,000. Because of this a member moved an amendment delaying erection for another year, but this was defeated. The scheme has already received the approval of the Electricity Commissioners.

Price Reduction.—The Town Council has decided to reduce the price of electricity by 15 per cent. as from January 1st. The new charges will be 75 per cent. above pre-war rates for lighting and 100 per cent. for power, heating and bulk supply.

Scarborough.—Price Revision.—The Electric Supply Co. has applied for an Order to charge 15s. up to 15 units in respect of the winter quarters, and 10s. up to 10 units for the summer quarters, and 1s. per unit beyond these quantities.

Skipton.—Loan.—In view of the agreement which has been entered into between the Urban District Council and the Keighley Corporation for a supply of electricity, the Urban District Council intends to apply for sanction to borrow £20,000, representing its portion of the cost of the scheme. The transmission line will be linked up to the old grammar school in Newmarket Street, from which electricity will be distributed to the town.

St. Annes-on-Sea.—Loan Sanctioned.—The Urban District Council has received the sanction of the Electricity Commissioners to the borrowing of £9,740 for the purposes of the electricity undertaking.

St. Helens.—Loan.—The Council is seeking the sanction of the Electricity Commissioners to a loan of £40,000 for electricity purposes.

West Bromwich.—Price Reduction.—At its meeting on December 7th the Town Council approved a reduction of 12½ per cent. in the charges for electricity for power purposes. The opinion was expressed that a further reduction was essential to manufacturers, and that the price of lighting energy should also be reduced. The Mayor said that an increased demand would permit of these reductions.

Worthing.—Loan.—The Electricity Committee has recommended that application be made to the Electricity Commissioners for sanction to the borrowing of £17,000 for extensions to the electricity works.

York.—Supply Contract.—The Council has entered into an agreement with the War Department for the supply of electricity to the Government offices in the city for three years. It is estimated that 70,000 units will be taken each year.

TRAMWAY AND RAILWAY NOTES.

Blackburn.—Report on Undertaking.—In accordance with the request of the Tramways Committee, Mr. A. R. Fearnley, M.Inst.A.E., has presented a report upon the Corporation tramway system. He was asked:—(1) Whether any reconstruction of the present system was desirable and practicable; (2) whether extensions were desirable; (3) whether motor omnibuses should be run either as supplementary to or independently of the tramways; (4) to advise the Committee as to its general policy. Mr. Fearnley says that the track, rolling stock, and overhead line are in good working condition, but with regard to the last, suggests that the side poles and short brackets be replaced, to give greater flexibility in working, by poles with longer arms. The Darwen track is corrugated and needs grinding and the Darwen authorities should be approached upon the matter. As regards services, Mr. Fearnley suggests through-running between various well-populated districts. Referring to term of reference (1) he is of opinion that the system does *not* require reconstructing. With reference to (2) he considers that extensions from Cherry Tree Station to Pleasington, from Wilpshire Section to Whalley, and from the Preston Road Section to the borough boundary on Preston New Road, are desirable and would be a good investment. Mr. Fearnley suggests, with regard to (3), that powers be obtained for running motor omnibuses on routes both within and outside the borough. On the question of general policy (4), Mr. Fearnley thinks that the existing uncertainty regarding the future of tramways will be counteracted by the continued downward trend of the cost of materials, and he considers that by the time powers have been obtained for carrying out extensions, the laying of permanent way will only entail a reasonable expenditure.

Central London Railway.—Extension of Time.—The Minister of Transport has extended the time of the Central London Railway Act, 1914, for the completion of the tunnels until July 1923.

Chesterfield.—No Penny Fares.—At a meeting of the Town Council on December 6th, an *ad hoc* sub-committee reported that it was unable to recommend the restoration of penny fares. It was stated that renewals, deferred during the war, would cost £10,000. The matter is to come up for consideration again next month.

Clay Cross.—Light Railway.—The Urban District Council has approved of a scheme for the construction of a light railway between Clay Cross and Ashover. The scheme is being promoted by the Clay Cross Co., Ltd., and the preliminary expenses are estimated at over £28,000.

Continental.—Switzerland.—The completion of the second Simplon tunnel was announced on December 4th, by *The Times'* Berne correspondent. An inaugural train ran to Iselle. The first tunnel was opened in 1906; the new tunnel was commenced from the Swiss side in 1912.

Italy.—*Il Sole* learns from Rome that a report has been laid before the Senate relating to the authorisation given to the Railway Administration to raise a sum of 440 million lire for special works. At present electric traction is employed on 559 km. of line with a track length of 1,045 km. The electrification of the direct lines Ronco-Arquata-Tortona, Tortona-Novi, Voghera-Bivio-Bormida and Genoa-Ovada-Alessandria has been begun. It is hoped to complete very shortly the electrification of the Rome-Tivoli and the Rome-Anzio-Nettuno lines, after which the works for the electrification of the direct Rome-Naples line will be pushed on. Thus at the beginning of 1923 another 500 km. of electrified lines may be completed with a track length of 1,370 km.

Since the construction of locomotives takes from 18 to 21 months, the Railway Administration has been obliged to give orders already, beginning with one for 111 locomotives at a total estimated cost of 165 million lire. The Government has authorised the Railway Administration by a decree law to raise 169 million lire for the acquisition of a further 120 electric locomotives.—*Reuter's Trade Service* (Milan).

Edgehill.—Extension of Time.—The Light Railway Co. has applied to the Ministry of Transport for an extension of time by one year, from January 28th, 1922, for the compulsory purchase of lands in respect of the Order granted in 1919.

Glasgow.—Tramway Purchase.—The Corporation has decided to purchase the Coatbridge and Airdrie tramways at a cost of £82,500.—*Daily Chronicle*.

London.—Working of New "Underground" Trains.—Careful analysis has been made of the working of the new trains on the District Railway, since their introduction, and it is stated that the results are very satisfactory. The new trains are providing in many ways that freedom of movement which is essential where there is great density of traffic. Figures prove that the new trains save from 2 to 3 seconds in loading and unloading at busy stations during the rush hours. That is a gain which is due largely to the door arrangement and to the improved facilities for egress and ingress. Furthermore, the new trains by their increased motor-power and improved braking are able both to start away and to slacken from full speed very much more quickly than the older stock.

Future Position of Tramways.—Giving evidence before the Royal Commission on London Government, which is considering the feasibility of a larger central administrative body for Greater London, Mr. Norman, L.C.C., said that the tramways in Greater London could be leased; there would be many applicants for them. It might be necessary for the proposed new Council to compulsorily acquire systems in outer London; special legislation would be necessary to secure this.

Luton.—Sunday Services.—It has been decided not to run tramcars on Sundays during the winter.

Manchester.—Christmas Services.—The Executive Committee of the Manchester branches of the United Vehicle Workers' Association has instructed the tramway employés to work on Christmas Day; a modified service will be run and the men will receive double pay.

The Stalybridge employés have also agreed to do duty on Christmas Day.

Newcastle-on-Tyne.—Longer Hours.—At a meeting of the City Council on December 7th, it was decided to rescind a previous resolution fixing the tramway employés' working week at a maximum of 44 hours. The chairman of the Transport and Electricity Committee said that it was necessary either to increase revenue or reduce expenditure. The imposition of higher fares was impracticable, but the working

of longer hours by the men would effect considerable economy. No men would be discharged as a direct consequence of this decision. The employés recently announced their intention to resist any attempt to lengthen the working week.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—Long-distance Wireless.—In moving the approval by the Federal Government of the draft agreement with Amalgamated Wireless, Ltd., for the erection of high-power wireless telegraph stations in Australia, Mr. W. M. Hughes, Prime Minister, referred to the recent messages transmitted from England, which were successfully received in Australia, and said that such transmission had been considered impossible by the Imperial Conference. The proposed capital would be 1,000,000 £1 shares, the Commonwealth taking half, with the controlling interest, which would be preserved in the event of an increase of capital.

The Federal Parliament has referred to a joint committee of the Chambers the rival proposals which have been submitted for communication direct with Great Britain. If, after investigation, either scheme is recommended with or without alteration, the Prime Minister will have the power to sign the contract. It is interesting to note that messages transmitted from the Post Office arc station at Leafield, which is working on low power pending the completion of the corresponding station in Egypt, are being received in Australia. According to a message from Sydney the morning newspapers in Australia are publishing news dispatched from Leafield, which has been picked up by the Perth wireless station. It is well known that news has been received in Australia and New Zealand during the last three years from several of the stations in France and Italy, which are equipped with Elwell arcs similar to those at Leafield.

Chile.—New Wireless Stations.—So as to enable Chile to correspond with the principal European and American stations, the Government is accelerating the installation of wireless stations in various parts of the Republic. The total cost of this project is estimated at £1,385,000, says *The Times*.

Christmas Telegrams.—The Post Office has made special arrangements with the Australian and New Zealand administrations for the delivery in those Dominions, on Christmas morning and New Year's Day, of telegrams of greeting sent from this country, at one-quarter of the usual rates. The price per word will be 9d. to Australia and 8d. to New Zealand. The telegrams may be handed in at any postal telegraph office not later than December 20th for delivery on Christmas Day, or December 28th for delivery on New Year's Day. The minimum charge will be 7s. 6d. to Australia and 6s. 8d. to New Zealand. Similar facilities are also provided for delivery in this country, on Christmas Day and New Year's Day, of greetings from Australia and New Zealand.

No special arrangements have been made for the delivery of greetings in Canada, but such messages can be sent by the deferred service "*Via* Imperial," for delivery on Christmas Day. The rate is 4½d. a word, with no minimum number of words.

Telegraph offices will be open in this country on Boxing Day and Bank Holiday, December 26th and 27th, from 9.30 to 11 a.m. Exceptional arrangements will be made for London. On Boxing Day telegrams for addresses beyond a radius of four miles from the Central Telegraph Office or the West Strand branch office will not be delivered after 4 p.m. —*The Times*.

Ireland.—Telegraph Control.—The annex to the agreement which was signed on December 6th by representatives of the British Government and by representatives of Dail Eireann on behalf of the Irish Free State states, in part, that (2) a convention shall be made between the British Government and the Government of the Irish Free State to give effect to the following conditions: (*a*) That submarine cables shall not be landed or wireless stations for communication with places outside Ireland be established except by agreement with the British Government; that the existing cable landing rights and wireless concessions shall not be withdrawn except by agreement with the British Government; and that the British Government shall be entitled to land additional submarine cables or establish additional wireless stations for communication with places outside Ireland.

(*c*) That war signal stations shall be closed down and left in charge of care and maintenance parties, the Government of the Irish Free State being offered the option of taking them over and working them for commercial purposes subject to Admiralty inspection and guaranteeing the upkeep of existing telegraphic communication therewith.

Italy.—Telegraphic Communication.—The Chamber discussed on December 7th the agreement with the Eastern Telegraph Co. regarding the working of the cable between Trieste and Corfu. Signor Giuffrida, Minister of Posts and Telegraphs, said it was simply a matter of substituting Italy for Austria-Hungary in the contract with the company. He added that the Government had obtained some concessions, and was convinced of the necessity of developing direct telegraphic communication between Italy and other countries, especially where there were important Italian interests. The agreement was approved.—*Reuter's Trade Service* (Rome).

Rhodesia.—Telephone Extensions.—It is announced officially that the Administration of Southern Rhodesia is to spend £10,000 on telephone materials during the next year. The Government is borrowing £450,000 in three equal yearly instalments from the Imperial authorities, and out of the first advance the amount mentioned above has been allocated for "additions to telephone systems and new installations.

Russia.—Telegraphic Communication.—The transmission of telegrams between Sweden and Russia is now possible, the Store Nordiske Co. having commenced a service of ordinary telegrams from Russia to Sweden. Radiograms have been sent since December 10th from Karlsborg to Petrograd by the Swedish Telegraph Office, and negotiations are in progress for the transmission of ordinary telegrams by the Store Nordiske Co. to Russia.—*Reuter's Trade Service* (Stockholm).

Sweden.—Wireless Navigation Reports.—The Swedish Government has recently approved proposals made by the Swedish Pilotage Board for co-operation between countries on the North Sea and the Baltic with regard to ice signalling by wireless. The proposals, effect to which was to be given at the close of November, comprised the issue of reports covering the entire Swedish coast from Haparanda to the Norwegian frontier regarding the condition of the ice, to be issued daily in cipher, the key to which is being published in the Swedish "Notices to Mariners." The messages are also to include information regarding wrecks, the withdrawal of lightships, and obstacles to navigation.—*Board of Trade Journal*.

CONTRACTS OPEN AND CLOSED.

(*The date given in parentheses at the end of the paragraph indicates the issue of the* Electrical Review *in which the "Official Notice" appeared.*)

OPEN.

Australia.—Melbourne.—February 1st. Victorian Government Railways. Four motor-driven grinding machines, with accessories.*

February 15th. Postmaster-General's Department. Telephone apparatus and parts (Schedule 544). (December 9th.)

Blackpool.—December 23rd. Electricity Committee. One 5,000-kW, 3-phase turbo-alternator, surface-condensing plant with auxiliaries; one 2,000-kW, phase and frequency changer, complete with exciter and starting motor. (December 9th.)

Bradford.—December 24th. Electricity Department. Rotary converting plant (Cont. R.207.) (December 9th.)

Edinburgh.—December 19th. Electricity Supply Department. Insulated cable for five months. (December 9th.)

London.—Shoreditch.—January 3rd. Electricity Supply Department. One water-tube boiler of 33,000 lb. evaporative capacity. (December 9th.)

L.C.C.—January 12th. One electric passenger lift, capacity 11¼ cwt., with full automatic push-button control, to be completed within two months, at Geoffrey House, Tabard Garden Estate, Bermondsey, S.E. (See this issue.)

New Zealand.—Wellington.—January 17th. Post and Telegraph Department, 25,000 dry cells for telephone work.*

Peterborough.—January 12th. Electricity Department. One 3,000-kW turbo-alternator with condensing plant, two 750-kW rotary converters, two 100-kW motor generators, e.h.p. and l.p. switchgear, steam, water, and drain pipes, foundations for the above plant, and structural alterations to existing buildings. (See this issue.)

South Africa.—Johannesburg.—January 4th. Municipal Council. Two 2,000-kW converters, with switchgear and spares.*

Spain.—February 1st. Harbour Works authorities at Vigo. Supply and erection of a 15-ton electric crane. Particulars from the Junta de Obras del Puerto de Vigo.

Uruguay.—Monte Video.—December 30th. State Electricity Department. Power station plant: one 4-stroke Diesel engine, coupled to a 200-kW, 3-phase alternator, and one 4-stroke Diesel engine, coupled to a 300-kW, d.c. generator.*

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—P.M.G.'s Department, Queensland.

16 tons bronze wire, 40 lb. per mile, £2,000; 21 tons bronze wire, 70 lb. per mile, £2,478.—British Insulated & Helsby Cables, Ltd.

P.M.G.'s Department, South Australia.

Equipment in connection with the extension of the main distributing frame at Central Exchange, £365.—British General Electric Co., Ltd.

P.M.G.'s Department, Western Australia.

Equipment in connection with the installation of four additional primary line switches and associated parts at Perth automatic exchange, £9,754. —Automatic Telephones (Aust.), Ltd.

P.M.G.'s Department, N.S.W.

Material required in connection with the installation of impulse-sending devices at various branch exchanges in Sydney, £1,240.—Automatic Telephones (Aust.), Ltd.

Victorian Electricity Commission.

Engine-room Buildings at Newport "B" power station, £32,000.—Babcock and Wilcox.

Rubber conveyor belts, £4,500.—Perdrian Rubber Co., Ltd.

25-cycle induction motors, with slide rails and pulleys, £1,011.—British General Electric Co., Ltd.—*Tenders.*

Ashford (Kent).—East Ashford Board of Guardians. Accepted:—

Installing electric light at the workhouse, £838.—H. S. Tett & Co., Ltd.

Belgium.—No fewer than eleven firms submitted tenders last week to the municipal authorities of Saventhem for the supply of a 165-kW dynamo, with accessories. The prices ranged from 44,250 fr. to 92,500 fr., the lowest offer being that of M. E. Goussens, of Saventhem.

Bradford.—Tramways Committee.

Copper rail bonds.—British Insulated & Helsby Cables, Ltd.

Steel cotters.—Crossley & Davenport.

Electricity Committee.

Transformers.—Hackbridge Electric Construction Co., Ltd.; Ferranti, Ltd.; Metropolitan-Vickers Electrical Co., Ltd.; British Electric Transformer Co., Ltd.

Dumfries.—Town Council. Accepted:—

Installing electric light at the slaughter house and stables, £155.—Dumfries Electricity Supply Co. (Electric Installations), Ltd.

London.—Hackney.—Electricity Committee. Accepted:—

Condensing water pipe work in connection with the extension of the Electricity Power House at Millfields Road, supply of pipes, £317.—Clay Cross Co., Ltd.

Valves for ditto: Two 36-in. valves, each with floor column and headstock, two 30-in. ditto, two 26-in. ditto, £795.—Blakeborough & Sons.

Stafford.—The Electricity Committee has accepted the tender of Callender's Cable & Construction Co., Ltd., for the supply and laying of 1,000 yards of l.p. cable in Newport Road.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, December 16th. At the Institution, Storey's Gate, St. James's Park, S.W. At 6 p.m. Papers on "Conveying and Elevating Machinery," by Mr. G. Mitchell and on "Discharge of Grain Cargoes in the Port of London by Pneumatic Elevators," by Mr. R. E. Knight.

Electro-Harmonic Society.—Friday, December 16th. At the Great Hall, Cannon Street Hotel. At 8 p.m. Smoking concert.

British Electrical Development Association.—Friday, December 16th. At the Institute of Patent Agents, Staple Inn Buildings, W.C.1. At 6 p.m. Paper on "Salesmanship in Relation to Electric Power-driven Machinery in the Home," by Mr E. R. Morton.

Junior Institution of Engineers.—Friday, December 16th. At Caxton Hall, Westminster, S.W. At 8 p.m. Paper on "Notes on Searchlight Construction and Operation," by Mr. A. J. Simpson.

Friday, December 30th. At Caxton Hall. At 8 p.m. Questions and General Discussion.

Institution of Electrical Engineers (Scottish Centre).—Saturday, December 17th. At the Grosvenor Restaurant, Gordon Street, Glasgow. At 7 p.m. Smoking concert.

Edinburgh Electrical Society.—Friday, December 23rd. At the Philosophical Institute. At 8 p.m. Paper on "Watts on Wheels (Automobiles and Accumulators)," by Mr. E. O. Catford.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

Queries addressed to the Electrical Review will be answered by post, if the desired information is available, provided the following simple rules are observed:—

1. Address your inquiries to the Electrical Review, Ltd., Service Department, *and enclose a stamped addressed envelope.*
2. Do not ask for information until you have satisfied yourself that it is not already contained in our advertisement pages.
3. If we are the means of putting you in touch with the firm or firms that you require, do us the favour of mentioning the Electrical Review.

No charge is made for the service.

Among the inquiries received this week, we have been unable to trace the names of makers or suppliers of:—

The Kyron heat giver.

The Motophone gramophone motor.

Eddy-Current Brakes for small motors up to 10 h.p.

NOTES.

Fatality.—While assisting riveters engaged upon a pitch tank at the National Oil Refineries, Skewen, on December 6th, Cyril Kreischer (19) was killed. It was his duty to hold an electric hand lamp, and it is believed he received a shock by this means. The other men had left the tank, and he was stepping out when he fell. Artificial respiration was tried without avail. It is less than a month since another workman was killed by electric shock on the housing site at the refineries.

The Human Need of Heat.—On December 13th, Mr. J. W. Beauchamp, M.I.E.E., lectured to the National Association of Supervising Electricians on "Artificial Heat in Relation to Human Needs." The lecturer explained that his idea was not so much to present a treatise upon the subject as to concu his hearers in the manner of conveying facts about heating to the lay mind. He gave a semi-medical explanation of the heat-absorbing and emitting functions of the human body, pointing out that artificial heat was required to enable the body to work in a congenial atmosphere; at the same time a constant perfectly-regulated temperature would soon cause the mentioned functions of the body to fall into disuse. Mr. Beauchamp then dealt with the three methods of heat transference —conduction, convection, and radiation—and their relative efficiencies. Conduction was a little-used method. Convection was efficient in cases where the air could be fairly well retained, and where draughts were absent. The emission of radiant energy was the function of many types of modern electric and gas heaters. Air, being diathermanous, was but sightly heated by the passage of radiant energy, the latter being converted into heat upon contact with solid bodies, such as human beings, walls, furniture, &c. Upon the whole, the best conditions for health and work probably lay in a mixture of convective and radiant heat. The temperature of the surrounding air in any room or workshop should be maintained at a reasonable value by convective heating; central heating by means of hot water met this requirement. In addition to this, radiant electric heaters should be employed to permit of a fair amount of temperature variation to meet individual requirements. The appreciation of radiant heat for this purpose was shown by the immense numbers of bowl fires which have been sold, even for use where electricity charges are high. In the early days of electric heating, a common appliance was a combination of radiant energy transmission, provided by large carbon-filament lamps, and convective heating, by means of elements run at a comparatively low temperature. There appeared to be still room for devices of this nature. The speaker then gave a short dissertation on the way in which to familiarise the uninitiated with quantitative conceptions of heat, as contrasted with temperature. He also gave examples of calculations to ascertain the amount of heat required in definite cases, and showed that scientific investigation practically confirmed the empirical "1¼ watts per cu. ft." used as a basis by heating engineers. He urged economy in the use of heat, saying that heat should be looked upon in much the same way as bread is. Speaking of modern applications of electric heating, Mr. Beauchamp instanced some Norwegian installations in which a constant supply of electricity was employed to heat the water in a large, central, lagged tank. The high load factor enabled electricity to be supplied at very reasonable rates. He also spoke of a similar experiment on a smaller scale in this country, where by means of alternate switching a constant supply of electricity could be used either for lighting, for heating the water in a small tank, or for both, by splitting the supply. A short discussion followed the lecture, and Mr. Beauchamp replied to a number of questions raised, admitting that the problem of what to do with excess heat in the hot-water systems mentioned, during summer, was a difficult one to solve in this country.

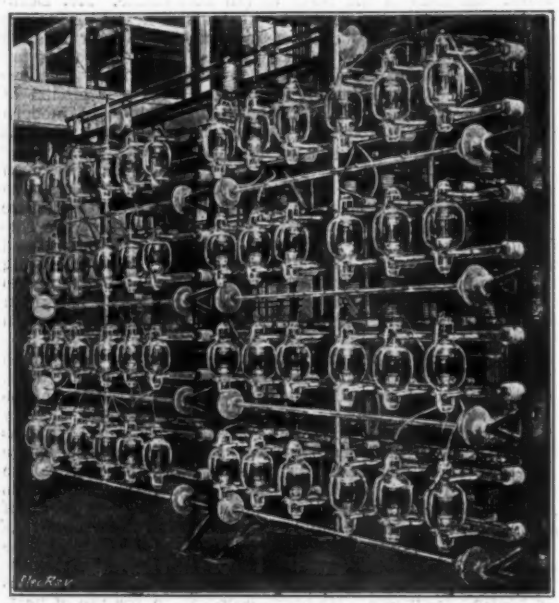
The Tramwaymen's Agreement.—At a conference of municipal tramway authorities convened by the Municipal Tramways Association last week, it was resolved that the 48-hour week should be retained, and that a committee of the National Industrial Council should be appointed to revise the agreement of March, 1919. A meeting of the Council was to be held yesterday in London.

Water-power Resources of the United Kingdom.—On Wednesday last the final report of the Water Power Resources Committee was issued. As it was received whilst we were going to press, we can only say, at the moment, that the Committee recommends that the collection of information regarding rainfall, &c., be continued; that financial aid be given by the State to undertakings during the constructional period; that long-term licences for the use of water-power be issued; that the Board of Trade or the Electricity Commissioners be charged with the supervision of water-power development, and that tidal power be investigated by a Technical Commission.

A Water Commission having jurisdiction over England and Wales only to have charge of the water resources of the country in the public interest, is also recommended.

Electric Vehicles in Italy.—A scheme for the reduction of the annual taxes on motor vehicles is at present being considered by the Italian Parliament. A feature of the new measure is that all taxes on electrically-propelled vehicles are to be abolished for a period of five years provided the vehicles are of Italian construction.

Direct Wireless to Australia.—In view of the interest that has been aroused by the proposal to form an Imperial chain of wireless telegraph stations, the announcement of the latest achievement of Marconi's Wireless Telegraph Co., Ltd., is of peculiar interest. Wireless test messages, prepared by an independent expert and transmitted in his presence, were sent direct to Australia on the evening of Sunday, November 20th, from the company's station at Carnarvon. Cable telegrams since received report the reception, complete on the first transmission, both at Sydney and Melbourne. The apparatus employed for this unique demonstration was a valve transmitter that is said to be the largest of its kind in the world. As will be seen from the accompanying illustration, it comprises a bank of 48 Marconi valves (a development of Dr. Fleming's invention) and each of the four dozen globes is about the size of a Rugby football. The importance of this successful long-distance transmission of wireless telegraph messages is self-evident, and the Marconi Co. is to be congratulated upon the rsults obtained.



Long Range Marconi Valve Transmitter.

According to the *Daily Mail*, Mr. Hughes, Australian Premier, tabled in the House of Representatives on November 24th, a draft agreement providing for the establishment of direct wireless communication between the Commonwealth and England. The company concerned undertakes always to remain an independent British concern and to construct forthwith the necessary stations. The main trunk stations in Australia and England are to be provided within two years, and an additional station in Canada, capable of communicating with Australia, is to be established. The charges for messages are not to exceed 2s. per word for the full rate; 1s. per word for the deferred rate; 6d. per word for the week-end rate; 1s. for Government, 5d. for Press, and 3d. for deferred Press messages.

The first Press message to be forwarded direct from England to Australia by wireless telegraphy was dispatched by the *Daily Mail* at the invitation of Marconi's Wireless Telegraph Co. on the evening of December 4th. It was handed in at Marconi's Fenchurch Street office and sent by wire to Carnarvon, whence it was transmitted by wireless by Captain Round. The message was received at the experimental station of Amalgamated Wireless (Australasia), Ltd., at Koo Wee Rup, near Melbourne, and at the Government station at Perth, on the west coast of Australia, the places being 1,800 miles apart. "Only a power of 160 kW was required to send the message, owing to the use of valves, whereas a few weeks ago 400 kW would have been needed."

London and Home Counties Electricity District.—Commissioners' Decisions.—We have received a statement of the decisions of the Electricity Commissioners on the schemes submitted at the local inquiry that was held in June and July last in connection with the above-named area, which we hope to deal with fully next week; its late arrival precludes its publication in this issue.

Briefly, it may be explained that the Commissioners have confirmed the provisionally delimited district, subject to certain minor fringe amendments. They have rejected the Poplar Borough Council's scheme and propose to establish a Joint Electricity Authority on the lines suggested in the schemes promoted by the L.C.C. and the Conference of Local Authorities. The Commissioners concur generally in the technical proposals for dealing with the requirements of the area during the *first* stage, terminating about 1925/6, for which they have already authorised the necessary generating plant. With regard to the *second* stage, however, the Commissioners differ from the promoters, who proposed to continue the development of existing "group" stations. The Commissioners' conclusion is that a better way is open— namely, to install the 199,000 kW of generating plant required in one or more capital stations, while retaining the "group" stations as developed during the first stage, and that the Barking site should be utilised for the construction of the first capital station, which will be required before 1926, and they will forthwith consent to its establishment by the County of London Electric Supply Co., Ltd. The Commissioners are not in accord with the view that a Joint Authority would be unable to generate electricity more cheaply than a railway company possessing its own generating station, and they are of the opinion that a supply from a common source will be advantageous to both parties. It appears to them that it should be possible by agreement to settle the terms of transfer of the selected stations, and negotiations on this matter are still proceeding. The Commissioners approve in principle of an extension of tenure as part of a settlement with the London companies, and the order establishing the Joint Authority is to be so drafted as not to interfere with the rights of the North Metropolitan Electric Power Supply Co., Ltd., or the bulk supply rights of the Metropolitan Electric Supply Co., Ltd. Regarding finance, it is proposed that authorised undertakers should find the funds for all extensions of generating plant at their stations while such stations remain in their possession, and for any inter-connecting mains required before the Joint Authority is in a position to act. The capital moneys necessary for the construction of additional inter-connecting mains and for the erection of the capital stations should be raised by the Joint Authority under borrowing powers, to be conferred by further legislation.

Appointments Vacant.—Cable jointer (84s. 8d.) and electrical and mechanical engineer (£500), for the Swindon Corporation Electricity and Tramway Department; assistant superintendent (450 Rs. per mensem), for the power station of the Madras Electric Supply Corporation, Ltd. (See our advertisement pages to-day.)

Power Factor and Charges for Electricity in Canada.—The Commercial Section of the Canadian Electrical Association has recentlly circulated a "questionnaire" on the above subject. Replies were received from eight of the largest supply companies in the Dominion.

Seven companies state they have clauses to correct for low power factor, while one company pays no attention to this subject as yet. Of the seven, two companies use the following clause in their agreements with power consumers:—

"All electrical apparatus made use of by the consumer shall be of good commercial efficiency, and such as to introduce no disturbing elements into the electrical system of the company. The minimum power factor of the motors when operating consumers' maximum load shall be as follows: Motors not exceeding five horse-power rated capacity, a power factor of not less than 75 per cent.; motors of over five horse-power and not exceeding ten horse-power rated capacity, a power factor of not less than 80 per cent.; motors over ten horse-power rated capacity, a power factor of not less than 85 per cent. If the power factor be found less than the above specified, then the power consumption shall be calculated on the basis of the minimum power factor so specified."

One company uses practically the same clause, stating that the consumer must maintain 80 per cent. power factor up to 10 horse-power rated capacity of motors and 85 per cent. power factor on motors over 10 horse-power rated capacity.

Another company uses the following clause:—"If at any time when power is being delivered to the customer at normal voltage and frequency the total volt-amperes so delivered exceeds that which would result if the power which the customer is then taking were delivered at a power factor of 85 per cent., the volt-amperes delivered shall be calculated as power upon the basis of 85 per cent. power factor."

Other clauses are: "The minimum power factor determined monthly shall not be less than 85 per cent." "If the power factor at maximum kVA be less than 85 per cent., then the total amounts of the accounts due for service under this contract shall be increased by dividing such amounts by the power factor as found and multiplied by 85 per cent." "It is agreed that the rates for service herein provided for are conditional upon the consumer's apparatus taking power at no lower factor than 70 per cent., and should his requirements be such as to cause the power factor in his supply circuit to fall below 70 per cent., then the rates for service herein provided for may, at the company's option, be increased by the amount of five per cent. for each per cent. the power factor of such service falls below 70 per cent."

With reference to correcting against serious conditions of current unbalance, no specific clauses are used by any of the eight companies.

To Alarm Burglars.—According to the *Evening News*, an "Italian gentleman" has invented an elaborate burglar alarm system. It consists in coating the inner side of walls and windows with insulated tinfoil and metallic paint. An "ever-so-gentle electrical current" circulates through the tinfoil, and when the tinfoil is punctured the current is interrupted. "When the circuit is broken in any way a heavy plunger cushioned on oil begins falling slowly down in a cylinder in the cellar, making contact with wires, which explode three harmless bombs at intervals of 15 seconds, and then set a bell ringing hard."

This is ingenious, but it would probably be cheaper and better to let the burglar carry on.

Electric Ship Propulsion.—The United States coastguard cutter *Tamoa*, the first of four electrically-driven cutters to be placed in service by the Treasury Department, has just been delivered to the authorities at the port of New York. She was built by the Union Construction Co., Oakland, Cal., and is 240 ft. long, 39 ft. beam, 25 ft. 6 in. deep, displaces 1,600 tons at a mean draught of 14 ft., and has a speed of 16 knots. The main propelling machinery consists of two Babcock & Wilcox water-tube boilers burning oil, which supply steam to a turbine-driven alternating-current generator. This in turn operates a 2,600-h.p. synchronous motor at a propeller speed of 130 r.p.m.—*Reuter's Trade Service* (New York).

U.S. Electric Vehicle Market.—The manufacturers of electric vehicles have arranged to hold monthly meetings in New York City, commencing in December, when the most prominent men in the trade will speak briefly on various phases of the industry. An electric vehicle show will be held in New York City, probably towards the end of January; the exhibition will be sponsored by the Edison Electric Co. A similar show held early this year was reported to have been highly successful from the manufacturers' point of view, so it is probable that there will be a record number of exhibits at the next exhibition.—*Reuter's Trade Service* (New York).

"British Trade Ship."—The board of the *British Trade Ship* publishes information which may be regarded as a barometer showing the present and prospective fall in costs of production. The terms for exhibiting have been reduced from between £2,100 and £1,350 for stalls to £1,400 and £900 respectively. The cost of showcases and countercases is similarly reduced to an average charge of about £400. First-class cabin accommodation for a trade representative undertaking the whole voyage of 18 months is reduced to the sum of £1,000, including all meals taken on board the ship. The significance of this reduction is a good omen for British trade and industry in the New Year.

INSTITUTION NOTES.

The Institution of Electrical Engineers.—Informal Meeting.—At the meeting of the Informal Section on Monday, December 5th, Mr. J. R. Bedford was in the chair, when Mr. C. L. Lipman opened a discussion on "Some Recent Developments in the Design of A.C. Instruments." The meeting was rather less crowded than recent meetings have been, and the discussion consisted mainly of interrogation from a few instrument experts. Mr. Lipman displayed numerous lantern slides showing the instruments in detail, and diagrams of connections, &c.; also, by the courtesy of Messrs. Nalder Bros. & Thompson, he was enabled to show some fine examples of the instruments. The power factor meters, frequency meters, synchronisers and synchroscopes described mainly embody an improved movement in which no moving coils are employed, with the result that extreme lightness, perfect balance and accuracy, and very small volt-ampere consumption are obtained. A special sensitive relay, primarily intended for use with Merz-Price and similar systems of protection, was exhibited; it was in principle similar to a moving-iron ammeter. The relay is self-setting, and is proof against violent external vibration. The Dransfield three-phase voltmeter was also exhibited.

South Midland Centre.—*Students' Section*.—At a meeting held on December 13th there was a debate on the "Relative Advantages of A.C. and D.C. for Power Distribution and Lighting in Sub-Station Areas." Mr. R. A. Chattock, M.I.E.E., Chairman of the Centre, occupied the chair.

Junior Institution of Engineers.—At the recent annual general meeting the following officers were elected for Session 1921-22:—Chairman, Mr. E. C. West; vice-chairman, Mr. H. V. Pointon; librarian, Mr. H. P. Wright; hon. treasurer, Mr. W. A. Tookey; hon. auditors, Messrs. J. M. Seddon, W. M. Murrel, S. H. Hole, and R. Cook; members of Council, Messrs. A. J. Simpson, L. Turner, W. H. Ballantyne, and G. W. Tookey. Mr. W. A. Tookey, in presenting the past year's accounts, expressed satisfaction that the deficit was not so great as had been anticipated, owing principally to increased revenue from advertisements and the care exercised by the Secretary and Finance Committee.

On December 9th Mr. C. H. Wordingham, C.B.E., delivered his address as President. The speaker covered wide ground, outlining the position of the various engineering institutions; the status of the engineer; the effects of industrial unrest; water power; fuel power; charges for power; power distribution; standardisation; the metric system; research; and other subjects of importance to engineers.

Institution of Rubber Industry.—At yesterday evening's meeting Mr. Fordyce Jones (chairman of the Reliance Rubber Co., Ltd.) was down to read a paper on "Widening the Field for Rubber Manufacturers."

Chelmsford Engineering Society.—On December 1st Mr. J. N. Houblon, M.I.E.E., of Messrs. Crompton & Co., Ltd., read a paper on "Small Public Electric Supply Undertakings," Mr. G. F. Barrett, O.B.E., the President, presiding. The lecturer dealt with the preliminaries necessary to start a small undertaking and the choice of prime movers; where steam was to be used the locomotive type of engine was recommended, and the "semi-Diesel" if oil fuel was decided upon, on account of low first cost and economy in running. D.c. supply was generally recommended, but for extensive districts an a.c. system was more economical. The question of mains was dealt with, and the author thought that in most cases a well-designed overhead system was more suitable, and considerably cheaper than underground mains, but it was essential for Government regulations to be modified, as they made the cost unnecessarily high. The lecture was illustrated by a large number of lantern slides, and an interesting discussion followed.

Birmingham and District Electric Club.—On December 10th Mr. N. Deykin was appointed chairman of the club. The membership has increased from 141 to 150, and the financial statement shows a credit balance.

Edinburgh Electrical Society.—At a meeting of the Society, held on December 9th, Mr. Arthur Whiteley gave an illustrated lecture on "Wireless." After dealing with the history and development of radio telegraphy and referring to the work of the outstanding inventors, the lecturer described the principles of spark and closed circuit transmission. Thermionic valves of various types and their application were shown. Mr. Whiteley gave descriptions of wireless stations in the East with which he had been connected, and concluded with a demonstration of a simple home-made receiver set. On behalf of the Edinburgh and District Radio Society, he invited his audience to an exhibition of wireless apparatus which is to be held in Gillespie's School on Saturday, December 17th.

Greenock Association of Electrical Engineers.—On December 6th Mr. Bucklitsch, of the Post Office Engineering Department, read a paper on "Intercommunication Telephones." The author gave details of various systems, automatic and manual, including the Strowger type. A vigorous discussion followed the paper, ranging from faults to phenomena in telephony.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

On Saturday last, at Cambridge University Church, Mr. W. L. Bragg, Professor of Physics at Manchester University, and son of Sir William and Lady Bragg, was married to Miss Alice Hopkinson, elder daughter of Mr. and Mrs. A. Hopkinson, of Cambridge.

Dr. John B. Whitehead, dean of the engineering school and professor of electrical engineering at Johns Hopkins University, U.S.A., has been awarded the five thousand francs prize of the Institute Electrotechnique Montefiore of Liége, Belgium, bestowed every three years for original work on the scientific advancement in the technical application of electricity. The prize was given for an essay on "The Corona Voltmeter and the Electric Strength of Air."—*Science*.

We are asked to contradict the statement appearing in our last issue respecting Mr. D. H. Davies's intentions to remain at Heywood, as he is taking up the appointment offered him at Chesterfield. Mr. Campion asks us to state that the Chesterfield vacancy for a general assistant advertised in November is therefore filled.

Mr. Frederic J. Barnett, who has been in the service of the Dominican Government for the past 7½ years as telephone and electric light superintendent, and may be coming home in the spring of 1922 on holiday, was recently presented with a baton and address by the Dominica Orchestral Society, of which he is the founder and conductor.

Mr. W. Price, meter testing superintendent to the Midland Electric Corporation for Power Distribution, Ltd., Ocker Hill, Tipton, is leaving to take up an appointment with the Bombay Electric Supply and Tramways Co. On Friday last a farewell dinner was given in his honour by his colleagues. The chief engineer, Mr. G. R. J. Parkinson, presided, and referred to Mr. Price's 19 years' satisfactory service with the company. The staff and employés had previously presented Mr. Price with a cabin trunk and dressing case.

Mr. R. W. EVERSON, formerly manager of the Merchandising Department of the Westinghouse Electric International Company, has left for Mexico City, where he has been assigned to the Mexican Office of the Westinghouse Electric International Company.

Mr. REG. L. THOMAS (late G.E.C., Hull) has joined the staff of the Electrical Engineering & Equipment Co., Ltd., of London, and will be stationed in Leeds.

Obituary.—Mr. JOHN GIBSON.—We regret to record the death, at the age of 48 years, of Mr. John Gibson, which occurred very suddenly on Friday last in London from cerebral hemorrhage. In earlier days Mr. Gibson was connected with Messrs. Ernest Scott and Mountain, Newcastle-on-Tyne, and Messrs. Holden and Brooke, Manchester, but for the last 15 or 16 years he was prominently associated with the supply business of the Metropolitan-Vickers Electrical Co., and was a director of the "Cosmos" Lamp Co. He leaves a widow and three children, to whom the many friends of the deceased gentleman will desire to extend their deep sympathy. The funeral took place on Wednesday in the Peel Green Cemetry, near Eccles.

Mr. G. W. TALBOT.—We regret to note from the "Deaths" column of *The Times* that Mr. George Washing Talbot, Postmaster-General and Director of Telegraphs, Burma, passed away at Anerley, S.E., on December 12th, at the age of 49 years.

MR. F. WORRALL.—The death took place on December 3rd of Mr. Frank Worrall, surveyor and electrical engineer to the Long Eaton Urban Council, with whom he had been for 24 years. He was 53 years of age.

Will.—The late Mr. J. H. BALFOUR-BROWNE, K.C., left £655,000.

NEW COMPANIES REGISTERED.

Dubilier Condenser Co. (1921), Ltd. (178,173).—Private company. Regd. December 2nd. Capital, £25,000 in £1 shares. To adopt an agreement with the Dubilier Condenser Co., Ltd., and to carry on the business of electricians, mechanical engineers, manufacturers of electrical condensers, electric, wireless and high tension protective apparatus, &c. The subscribers are (each with one share) are: A. C. Banks, 21, Woodland Road, New Southgate, N.11, clerk; L. O. C. Hathaway, 90, Cavendish Road, South Side, Clapham Common, S.W., clerk. The subscribers are to appoint the first directors. Qualification: £100. Remuneration as fixed by the company. Registered office: Ducon Works, Goldhawk Road, Shepherd's Bush, W.12.

Aqua Electric Co., Ltd. (178,170).—Private company. Registered December 2nd. Capital £8,000 in £1 shares. To acquire the undertaking and all or any of the assets and liabilities of the Aqua Electric Co., Ltd. (incorporated in March, 1921), and to carry on the business of electrical, gas and water engineers, machinists, fitters, millwrights, mechanical engineers, &c. The subscribers (each with one share) are: Woolf Barnato, 14, Hanover Square, W., gent.; Ernest F. Spencer, 37, Park Mansions, Vauxhall Park, S.W.8, engineer. The subscribers are to appoint the first directors. Qualification: 100 shares. Remuneration 1 guinea each per board meeting attended. Registered office: 116, Putney Bridge Road, S.W.15.

Electric and Railway Finance Corporation, Ltd. —(178,213).—Private company. Capital, £500,000 in £1 shares. The objects are: To carry on the business of a trust, finance, land, mortgage and agency company, to carry out financial and commercial operations of all kinds, to purchase, underwrite, subscribe for or otherwise acquire, hold and deal in investments and securities of all classes, whether British, Colonial or foreign, to establish or promote companies and to form and manage syndicates; also to carry on business (solely or jointly with others) as engineers, railway and building contractors, manufacturers and repairers of railway and other materials and rolling stock, manufacturers of electrical apparatus and machinery, general electrical engineers, ship builders and repairers, &c. The signatories to the Memorandum of Association (each subscribing for one share) are: J. Coneybeare, 32a, Quinton Street, S.W.18; L. H. Butcher, 52, Gaskarth Road, S.W.12; and J. W. Sanders, 66, Henry Street, S.E.11 (all clerks). The first directors (to number not less than four nor more than nine) are to be appointed by the subscribers to the Memorandum of Association. Qualification: £1,000 registered shares or stock. Remuneration as fixed by the company. The registered office is at 2, Bond Court, Walbrook, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Oswestry Electric Lighting and Power Co., Ltd.—Debenture dated September 27th, 1921, to secure £1,500, charged on the company's undertaking and property, present and future, including uncalled and unpaid capital. Holders: London County, Westminster and Parr's Bank.

Cox-Cavendish Electrical Co., Ltd.—Particulars of £6,000 debentures. Authorised September 16th, 1921. Present issue £2,150, charged on the company's undertaking and property, present and future, including uncalled capital.

Tramway Supplies, Ltd. (93,698).—Capital £10,000, in £1 shares. Return dated October 28th, 1921. 5,307 shares taken up. £2,307 paid. £3,000 considered as paid. Mortgages and charges £8,908 15s. 5d.

George H. Scholes & Co., Ltd. (106,845).—Capital £3,000 in £1 shares (5,000 pref. and 3,000 ord.). Return dated September 14th, 1921. 2,336 pref. and 2,002 ord. shares taken up. 1,932 paid on 1,950 pref. and 2 ord. £2,386 considered as paid on 386 pref. and 2,000 ord. Mortgages and charges nil.

Sentinel Instrument Co., Ltd.—Mortgage dated November 29th, 1921, to secure £2,500 and further advances charged on 43/45, Shields Road West, Newcastle-on-Tyne. Holders: Newcastle-upon-Tyne Permanent Building Society.

Cambridge Electric Supply Co., Ltd.—Particulars of £3,000 debentures authorised October 26th, 1921. Present issue £2,450, charged on company's undertaking and property, present and future.

Comac Manufacturing Co., Ltd.—T. L. Constable, of 110, Clifton Road, Norbiton, Surrey, was appointed receiver on October 25th under powers contained in debenture dated April 20th, 1921.

Cumberland Coal Power and Chemicals, Ltd.—Particulars of £200,000 8 per cent. six months' secured notes authorised November 22nd, 1921, and covered by trust deed of even date; present issue £160,000, charged on rights and interests in an agreement relating to the purchase of, and certain shares in, the S/A Tyssejaldene Co. and the company's undertaking and property, present and future, including uncalled capital. Trustees: Sir Arthur T. Dawson, Bt., Vickers House, Westminster; and A. E. Barton, Nitrogen House, 31 and 32, Grosvenor Place, S.W.

Frinton-on-Sea & District Electric Light & Power Co., Ltd. (70,689).—Return dated October 31st, 1921. Capital, £10,000 in £1 shares (7,300 preference and 2,700 ordinary). All shares taken up and paid for in full. Mortgages and charges, £10,000.

Magic Appliances, Ltd.—Particulars of £2,000 debentures, authorised October 20th, 1921; whole amount issued; charged on the company's property, present and future, including uncalled capital (subject to £2,000 prior debentures).

Lowth & Smith, Ltd.—Charge on the company's undertaking and property, present and future, including uncalled capital, dated December 2nd, 1921, to secure £500. Holder: T. Davies, Wesley Street, Levenshulme, Manchester.

James Keith & Blackman Co., Ltd.—Satisfaction in full on November 11th, 1921, of debentures dated October 29th, 1901, and January 1st, 1913, securing £500 and £50 respectively.

CITY NOTES.

London Underground Railways.

THE COMMON FUND.—At meetings of the boards of directors of the City and South London, Central London, London Electric, and Metropolitan District Railway Companies, and the London General Omnibus Co., Ltd., last week, it was decided, after a review of the results of the operation of the common fund for the present year and of those of the last five years, to recommend to the stockholders that the following variation in the division between the companies of the common fund established under the London Electric Companies' Facilities Act, 1915, should be agreed. The common fund, as our readers know, is made up of the balances of the net revenues of the several companies after providing for interest and dividends on their prior charge securities (except Metropolitan District Railway Second Preference Stock) and for depreciation and reserve. The variations are shown in the table below:—

Company.	Original share. Per cent.	Revised share. Per cent.
City and South London	6	6
Central London	20	16
London Electric	30	41
Metropolitan District	12	12
London General Omnibus	32	25
	100	100

While the percentage share of the Metropolitan District Railway Co. remains unchanged it is proposed that the Second Preference Stock of that company should be included as a revenue liability, so that the interest upon the stock is to be met prior to the distribution of the common fund. These revisions are to take effect from July 1st, 1921. It is also proposed at the same time to make certain minor amendments in the common fund agreement which the experience of the last six years has shown to be desirable. A circular will be issued to the stockholders setting out the whole position fully.

Cordoba Light, Power & Traction Co., Ltd.—The report for the year ended March 31st last records a trading profit of £123,923. After paying interest on debentures, promissory notes, &c., a balance of £54,625 remains, which, with £60,016 brought forward, totals £114,641. Of this £8,432 is appropriated for debenture stock redemption. Subject to approval the sum or £69,300 is transferred, in respect of 5½ years' arrears of dividend on the preference shares, together with £6,300 from the profits of the past half-year. £5,000 is being transferred to the share redemption fund. The annual contribution of £5,000 is calculated to repay the whole of the share capital within the time of the concessions of subsidiary companies. Meeting: December 20th.

C. A. Vandervell & Co., Ltd.—The report of trading for the year ended March 31st shows a very considerable loss (£251,472). £75,000 has been withdrawn from reserve, and the £140,499 brought forward has also been absorbed to meet the deficiency. We shall quote the report more fully next week.

Manx Electric Railway Co.—The directors are paying a dividend of 5½ per cent. on the preference shares for the year ended September, 1916, and carrying £916 forward.

Eastern Extension, Australasia & China Telegraph Co., Ltd.—Interim dividend for the quarter ended September 30th of 5s. per share, free of income tax.

Prospectuses.—*Newcastle-upon-Tyne Electric Supply Co., Ltd.*—The list of applications opened on Monday, and was to remain open until to-morrow, in an issue of £750,000 of 6 per cent. second mortgage debenture stock at £85½ per cent. The issue is for the purpose of providing funds to meet the company's commitments incurred in connection with the extension of its generating stations, mains, and sub-stations, and for the development of the business generally. The issue was oversubscribed, and the list closed on Monday, but provincial applications were considered if received on Tuesday by first post.

Reading Electric Supply Co., Ltd.—This company has been offering for subscription (the list was announced to close to-morrow, 17th inst.) £100,000 7½ per cent. first mortgage debenture stock at 95 per cent. The issue has been made of the repayment of an advance of £15,000 to the bankers to redeem existing debentures amounting to £32,000 and to provide funds for extensions to the generating and distributing system. The list was closed on Monday; provincial applications were considered if received on Tuesday by first post.

Llanelly and District Electric Lighting and Traction Co., Ltd.—The subscription list was to close on or before December 17th in an issue of £125,000 7½ per cent. debenture stock at 94 per cent. The proceeds of the issue will be sufficient to discharge all capital commitments to date in respect of works recently completed (including repayment of loans expended on such works), and will be utilised for this purpose and for the general purposes of the company.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under Rule 148a:—

Telephone Manufacturing Co. (1920).—310,000 (Vendors') shares of £1 each, fully paid, Nos. 8 to 310,007.

Application has been made to the Committee to allow the following to be officially quoted:—

General Electric Co.—£3,500,000 7 per cent. mortgage debenture stock.

The undermentioned securities have been ordered to be officially quoted:—

General Electric Co.—50,000 6½ per cent. "A" cumulative preference shares of £1 each, fully paid (Nos. 1,655,791 to 1,705,790).

Lancashire Electric Light & Power Co.—65,025 6 per cent. (Income Tax free up to 6s. in the £) cumulative convertible first preference shares of £1 each, fully paid (Nos. 400,001 to 465,025).

North Metropolitan Electric Power Supply Co.—£228,460 7½ per cent. debenture stock.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—A meeting of the holders of the second mortgage debenture stock was held last week, and resolutions were passed modifying the rights of the holders of the second mortgage debenture stock. Mr. R. P. Sloan, C.B.E., who presided, said that the provisions were that the interest payable on the stock should be increased from 5 per cent. to 6 per cent., and that the authorised amount should be increased from £500,000 to £2,000,000. The company had on hand applications for large additional supplies, and it was necessary that further capital should be raised. The amount realised by the issue of second debenture stock would be spent entirely on new works.

Tees Power Station Co., Ltd.—The report for the year ended October 1st states that 167,827 fully-paid ordinary shares have been allotted to the Newcastle-upon-Tyne Electric Supply Co., making the total issued and paid-up capital £437,577. The amount received from the Newcastle company was £20,977, which, with a balance of £306 brought forward, gave a total of £21,283. Of this £20,800 will be absorbed by a dividend of 4½ per cent. on the paid-up shares, the balance being carried forward.

Para Telephone Co.—An interim dividend on the ordinary shares of 3 per cent., free of tax, is announced.

Italian Capital Increase.—The firm of Pirelli & Co., of Milan, who have a share capital of 100,000,000 lire, are offering for subscription 40,000 new shares of 500 lire, which will raise the capital to 120,000,000 lire.

Tube Investments, Ltd.—At the annual meeting, on December 7th, the chairman referred to the formation of Bromford, Ltd., as a separate concern, stating that £100,000 remained as a debt to the vendors, Tubes, Ltd. Orders were at present only sufficient to occupy half the factory, but improvement was expected.

A Swiss Investment Company.—The Columbus Electrical Undertakings Co., of Baden, reports net profits of 2,750,000 francs for 1920-21 and a dividend at the rate of 8 per cent., as in the preceding year. The chief assets held are in the Compania Italo-Argentina de Electricidad, of Buenos Ayres.

Yorkshire (West Riding) Electric Tramways, Ltd.—A final dividend of 3 per cent. (at the rate of 6 per cent. per annum) on the preference shares, less tax, is announced for the past half year.

Electro-Bleach and By-Products, Ltd.—An interim dividend of 3½ per cent. is to be paid on the preference shares.

Norway.—The accounts of the Norsk Hydro-Elektrisk Kvaelstof A.S., of Christiana, show a deficit of 1,308,000 kr. for 1920-21. It has, however, been decided to pay a dividend at the rate of 15 per cent., by the absorption of the profit-equalisation fund and an appropriation from the contingency fund.

Rees Roturbo Manufacturing Co., Ltd.—A dividend of 5 per cent. on the preference shares for 1917 is reported.

STOCKS AND SHARES.

Tuesday Evening.

The rise in gilt-edged securities goes on so regularly as to make its recording almost a matter of monotony, though this is broken by the pleasure it affords to chronicle movements which must be gratifying to wide circles of investors. For the rises in the War Loan and other gilt-edged securities have their effect upon investment stocks and shares of all classes. As prices of the former improve, so the attention of the investor tends to become directed more and more to other stocks and shares that have not advanced in the same ratio as those of the purely gilt-edged group. Of course, the improvement is sometimes contemporaneous, as may be instanced by the fact of the County of London 7 per cent. debenture stock, issued at 94, having risen this week to 10½ premium, making the fully-paid stock equivalent to 104½.

The Midland County Electric 7½ per cent. mortgage debenture stock, issued at 96, has scarcely started to move, the premium to-day being about 10s., at which price the yield on the money comes to 7¼ per cent. The first coupon, due next March, is for £1 2s. 6d. per cent., after which, of course, the full 3¾ per cent. will be paid every September and March. The security is good enough to warrant a rise of several points. The Shropshire, Worcestershire & Staffordshire Electric 7½ per cent. debenture stock, the price of which hung at a small discount for several weeks after the allotment, has now risen to 3 premium above the 97 at which the stock was offered. The yield here is 7¼ per cent. with a small coupon due next March. The stock is redeemable in 1931 at 100, and it may be recalled that it carries the guarantee, both as to principal and interest, by the British Electric Traction Co., besides being convertible at any time into Shropshire shares. The Mersey Power 7½ debenture stock, also issued at 97, has advanced to 3 premium. General Electric 7 per cent. debenture is up to 98¼, and the British Thomson-Houston, which came out at the beginning of the month at 92½, commands a small premium. The first interest on this scrip being a "broken amount," is due next May.

The Clyde Valley Electrical Power 8 per cent. second preferences, with £5 paid out of the £10 nominal value, can be bought at a shade over par, offering a trifle under 8 per cent. on the money, with a small dividend due this week. City of London 8 per cent. seconds at 23s. 6d. pay 6¼ guineas per cent. on the money, and Notting Hill 6 per cent. non-cumulative preference at 7½ afford practically 8 per cent. with a dividend due next month. The shares rank equally for repayment of capital with the company's 6 per cent. cumulative preference.

One of the Stock Exchange features of the past few days, has been a substantial rise in the price of District Railway ordinary stock. The Underground Railways has formulated a scheme varying the terms of the Common Fund to which all the tube railways contribute. A circular is on the point of issue in which full details will be given, and the arrangement is proposed on the ground that the division of distribution, as it stands at present, is scarcely equitable to some of the companies concerned. The new proposals bring within sight a dividend on District ordinary in respect of the current year, and this has caused a rise of 4 points in Districts to 22. Underground Electric shares are 10s. higher at 2½, the shilling shares advanced to 6s. and the Income Bonds are no less than 6 points better at 73¼.

City of London Electric ordinary shares at 1 7/16 have risen a florin, and Kensington ordinary improved to 5. On the other hand, County of London ordinary at 8¾ are 1/16 down, there being two or three hundred shares in the market, which are being digested by quiet degrees. South Metropolitan preference stiffened to 17s. 6d. and the second preference rose to 13s. 9d.

English Electric Notes are better at 99. Yorkshire Electric Power ordinary shares at 8¼ are 5s. higher. The Newcastle-on-Tyne Electric Co. has been offering £750,000 6 per cent. second mortgage debenture stock at 85½. The subscription-list was promptly filled and closed several days in advance of the full time to which it could have remained open. The Reading Electric Supply Co. offered £100,000 7½ per cent. first mortgage debenture stock at 95, and the Llanelly & District Electric Lighting & Traction Co. issued £125,000 7½ per cent. debenture stock at 94. In both cases, the stock was promptly snapped up, and the market for all such securities is a good one. Several others are expected to make their appearance in the near future.

Anglo-Argentine Tramway debenture stock has risen to 63¾. British Columbia Electric deferred at 57½ and the debenture

stock at 61½ are both better. The Mexican group is not quite so excited this week, the only change being a rise of a point in Mexican Light & Power preferred shares.

The Cable group is rather better. Eastern ordinary recovered a couple of points, at 163½, but Globe ordinary at 16½ fell ½, the other members being unchanged. Anglo-American Telegraph preferred at 83 is ½ higher, and the deferred at 18 shows another rise of 5s., owing to the advent of the dividend due early in the New Year. Business has been done in Indo-Europeans at 27 and the price of the shares is lowered to 27½ middle. As an important part of the company's concession runs out in 1925, it is being asked whether the present may not be an opportune time for making advance arrangements towards a voluntary dissolution of the company. On the company's balance-sheet, there should be well over £40 per share for the proprietors. The line runs through Germany and part of Russia, but it is understood that efforts are being directed towards straightening-out a position severely tangled-up by the war. The directors' task is manifestly a difficult one. Marconis hold their price at 1 11/16, and Marines at 20s. 9d. have recovered, after being down to 19s. 6d.

The rubber share market is in a humdrum state, prices moving scarcely at all. Vickers rose briskly to 9s. 3d., on a report that the new ten million pounds loan which India is raising is required, in part, for railway construction, in which big British firms will be given a participation. Armstrongs improved at the same time. Babcock & Wilcox advanced to 2⅛, and the markets in manufacturing shares are as a whole decidedly brighter than they have been for some time past. Edisons at 6s. are ninepence up. Electric Constructions strengthened to 18s. 3d. Cromptons continue depressed. General Electric gained sixpence, and Henley's preference are 2s. 6d. to the good.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend. 1919.	1920.	Price Dec. 13, 1921.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	12	12	6⅜	—	£9 18 6
Charing Cross Ordinary	7	8	4½	—	8 17 10
do. do. do. 4½ Pref.	4½	4½	3⅛	—	7 4 4
Chelsea	4	6	3½	—	9 4 8
City of London	13	14	1⅞	+1⅛	9 14 10
do. do. 6 per cent. Pref.	6	6	18/-	—	6 13 4
County of London	8	8	8⅜	— ⅛	9 2 10
do. do. 5 per cent. Pref.	6	6	7⅛	—	7 10 0
Kensington Ordinary	7	9	5	+ ½	9 0 0
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	3	—	10 0 0
Metropolitan	6	7	8⅝	—	9 6 8
do. 4½ per cent. Pref.	4½	4½	2½	—	7 13 2
St. James' and Pall Mall	12	12	6⅜	—	8 17 10
South London	6	7	2⅜	—	10 13 2
South Metropolitan Pref.	7	7	17/6	+ 1/6	8 0 0
Westminster Ordinary	10	10	5⅛	—	8 10 2
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	8⅜	+ ⅜	7 4 7
do. Def.	1½	1½	18	+ ½	8 6 8
Chile Telephone	6	6	5½	—	5 17 3
Cuba Sub. Ord.	7	7	7	—	10 0 0
Eastern Extension	10	10	16⅜	—	6 2 2
Eastern Tel. Ord.	10	10	160½	+2	6 2 4
Globe Tel. and T. Ord.	10	10	16½	— ⅛	6 3 1
do. do. Pref.	6	6	9½	—	6 9 9
Great Northern Tel.	22	24	25	—	9 12 0
Indo-European	10	10	27½	—2½	9 2 0
Marconi	25	15	1⅞	—	8 17 10
Oriental Telephone Ord.	12	12	2	—	*6 0 0
United R. Plate Tel.	8	8	5½	—	*7 0 8
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	16⅜	—	*6 2 2
Home Rails.					
Central London Ord. Assented	4	4	40½	—	8 1 8
Metropolitan	1½	1½	26½	+1½	5 17 8
do. District	Nil	Nil	22	+4	Nil
Underground Electric Ordinary	Nil	Nil	2½	+10/-	Nil
do. do. "A"	Nil	Nil	6/-	+1/-	Nil
do. do. Income	4	2	73½	+6	*4 1 0
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	5½	12½	32	—	10 9 6
do. do. 2nd Pref.	Nil	5½	2⅜	+ ⅛	8 0 0
do. do. 5 per cent. Deb.	5	5	63½	+ ½	7 17 6
Brazil Tractions	Nil	Nil	31	+1	Nil
British Columbia Elec. Ry. Pfcs.	5	5	58	—	8 12 4
do. do. Preferred	5	92/-	51	—	*9 5 9
do. do. Deferred	3	124/-	57½	+1	*10 17 6
do. do. Deb.	4½	4½	61½	+1½	6 18 3
Mexico Trams. 5 per cent. Bonds	Nil	Nil	55½	—	—
do. do. 6 per cent. Bonds	Nil	Nil	27½	—	Nil
Mexican Light Common	Nil	Nil	18	—	Nil
do. Pref.	Nil	Nil	27	+1	Nil
do. 1st Bonds	Nil	5	61½	+4	8 2 8
Manufacturing Companies.					
Babcock & Wilcox	15	15	2⅛	+⅛	6 14 9
British Aluminium Ord.	10	10	14/6	—	—
British Insulated Ord.	15	15	1½	—	10 0 0
Callenders	15	15	1⅜	—	10 18 2
,, 6½ Pref.	6½	6½	18/9	—	6 18 8
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	—	6/-	+9d.	—
do. do. 5 per cent. Deb.	5	5	64	—	7 16 3
Electric Construction	10	10	18/3	+9d.	10 19 2
English Electric	8	8	10/-	—	16 0 0
do. Pref.	6	6	12/6	—	9 12 0
Gen. Elec. Pref.	6½	6½	17/-	—	7 12 0
do. Ord.	10	10	17/6	+6d.	11 8 6
Henley	15	15	29/3	—	10 5 7
do. 4½ Pref.	4½	4½	3⅝	+ ⅛	6 4 2
India-Rubber	10	—	⅞	—	—
Met.-Vickers Pref.	8	8	13	—	9 2 10
Siemens Ord.	10	10	17/-	—	*9 8 2
Telegraph Con.	20	20	21½	—	*5 11 9

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, December 14th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic per lb.	8½d.	½d. dec.
a Ammoniac Sal per ton	£56	..
a Ammonia, Muriate (large crystal) ,,	£58	..
a Bisulphide of Carbon ,,	..	..
a Borax ,,	£31	..
a Copper Sulphate ,,	£20	£10 dec.
a Potash, Chlorate per lb.	6d.	½d. dec.
a ,, Perchlorate ,,	6d.	..
a Shellac per cwt	£16 14s.	16/- dec.
a Sulphur, Sublimed Flowers ,,	£14 10s.	10/- dec.
a ,, Lump ,,	£13 10s.	10/- dec.
a Soda, Chlorate per lb.	3½d.	..
a ,, Crystals per ton	£7	..
a Sodium Bichromate, casks per lb.	6½d.	..
METALS, &c.		
p Babbitt's Metal and Anti-friction Metal—		
Grade I per ton net	£160	..
Grade II ,, ,,	£118	..
Grade III ,, ,,	£71	..
c Brass (rolled metal 2" to 12" basis) per lb.	1½d.	..
c ,, Tubes (solid drawn) ,,	1/0½ to 1/0½	..
c ,, Wire, basis ,,	11½d.	..
c Copper Tubes (solid drawn) ,,	1/2½	..
c ,, Bars (best selected) per ton	£101	..
c ,, Sheet ,,	£101	..
c ,, Rod ,,	£101	..
d ,, (Electrolytic) Bars ,,	£75 5s.	30/- dec.
d ,, ,, Sheets ,,	£145 10s.	..
d ,, ,, Wire Rods ,,	£91 5s.	30/- dec.
d ,, ,, H.C. Wire per lb.	11⅛d.	½d. dec.
f Ebonite Rod ,,	3/0	..
f ,, Sheet ,,	3/-	..
g German Silver Wire ,,	2/9	..
h Gutta-percha, fine ,,	12/6	..
h India-rubber, Para fine ,,	1/0½	½d. inc.
i Iron Pig (Cleveland Warrants) per ton	Nom.	..
i ,, Wire, galv. No. 8, P.O. qual. ,,	£27	£1 dec.
g Lead, English Pig ,,	£27	..
g Mercury per bot.	£10 5s. to £10 10s.	..
e Mica (in original cases) small per lb.	3d. to 8/-	..
e ,, ,, ,, medium ,,	4/- to 8/-	..
e ,, ,, ,, large ,,	10/- to 90/- & up	..
p Phosphor Bronze, plain castings ,,	1/3	..
p ,, ,, drawn bars and rods ,,	1/4½	..
p ,, ,, rolled strip & sheet ,,	1/4½	..
p ,, ,, Wire ,,	1/5½	..
d Silicium Bronze Wire per lb.	1/2½	..
r Steel, Magnet, in bars ,,	1/-	..
n Tin, Block (English) per ton	£169	£7 15s. inc.
n ,, Wire, Nos. 1 to 16 per lb.	3/0	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Appeal for the Blind.—It is hoped that the lamented death of Sir Arthur Pearson will not occasion any cessation of activity, or falling-off in generosity, on behalf of the Blinded Soldiers' and Sailors' Hostel at Regent's Park. Sir Arthur will always be remembered for his zeal on behalf of those who suffered from the same tragic loss that darkened his own vision, and it is profoundly to be hoped that the appeal that has been issued by his son for full and continued support to be given to St. Dunstan's and the National Institute for the Blind will be readily responded to, both in memory of Sir Arthur and in the interests of our blinded heroes.

Fire.—Damage to the extent of £80,000 was caused by a fire at the Fellmongering Works of the Pontefract Co-operative Wholesale Society on December 6th. A wool building, containing newly-installed electric power plant, was totally destroyed

Forthcoming Air Conference.—The Air Ministry announces that the first Air Conference proved so useful that the Air Council has decided to call together another conference, which will be held by permission of the Lord Mayor and Corporation, at the Guildhall, on February 7th and 8th, 1922. The conference will, on this occasion, be asked to address itself mainly to the question of the future of aviation, with special references to its development as a regular and speedy form of commercial transport. The papers will be divided into two main groups, the one dealing with civil aviation in general, and the other with technical problems, the papers on the former subject being delivered at the morning session of the first day, and the papers on the latter during the afternoon session of the same day. The proceedings on the second day will be devoted wholly to discussions arising out of the previous day's papers, the morning session being allotted to civil aviation, and the afternoon to discussions on technical papers. The Secretary of State for Air will preside during the civil aviation portion of the proceedings, and Lord Weir of Eastwood during the technical sessions.

ELECTRIC HEATING.

By JULIUS FRITH, M.Sc., M.I.E.E., M.Cons.E.

It is common to hear the opinion expressed that one radiator or type of radiator is more "efficient" than another. Every electrical engineer knows, however, that one kilowatt-hour yields 3,430 British thermal units, and that heat is the one thing that we can make with absolute 100 per cent. efficiency. Are, then, the people who profess to judge between the efficiency of one or the other radiator all either knaves or fools? I think not, and that there is more in this matter than meets the eye.

An electric radiator can give out its heat in two quite different ways, either as direct heat or as radiant energy, which is not heat at all, and only becomes heat when it strikes something material and, becoming absorbed, is converted into heat.

There is a wretched expression common amongst the thoughtless, namely, "radiant heat," which really carries its own condemnation, as heat, being a vibration of gross matter, cannot be radiant; radiant energy is a disturbance in the ether, which can be caused by a hot body and which can again heat a body, but which is no more heat than a belt is power. We do not know the precise mechanism by which a hot body can wag the ether and cause vibrations to be set up in it, but all hot bodies can do it, and the hotter they are the more they do it.

Heat is a vibration of the particles of gross matter, and so cannot exist apart from gross matter. The heat from the sun, or from the filament of a vacuum lamp, reaches us through a space empty of gross matter, and, therefore, cannot have been heat but must have been an ether vibration or radiant energy.

Therefore it is seen that the expression "radiant heat" is a blunder essentially similar to that involved in trying to catch a sunbeam with a pair of tongs.

But to return to our radiators: it is possible at will to convert the kilowatt-hour into either nearly all radiant energy or nearly all direct heat. As an example of the first, one might cite a thousand candle-power of metal-filament vacuum lamps and of the second 3,000 yards of No. 18 copper wire carrying 5 amperes. Each of these, if placed in a room, would liberate in that room 3,430 B.th.u. per hour; in the case of the lamps it might be necessary to pull the blinds down or a (very) small portion would escape through the windows as light.

Now, without stigmatising either of these as inferior or less efficient than the other, it is obvious that they would have different effects on the occupants of the room. I would even go so far as to say that one might be more suitable in one case and the other in another.

Let us try and see clearly in what the difference lies. In the case of the lamps, the radiant energy would travel through the glass and the air, if both were reasonably clean, without appreciably raising their temperature, and would finally strike either the furniture or other solid bodies in the room or else the walls. If these solids were dull black, the radiant energy would be almost immediately absorbed and converted into heat; if they were white and bright, a part of it would be so absorbed and converted at the first impact and part would be reflected back and forth till it was at last all absorbed. The air in the room would then be heated from the solids, but this, as will be shown presently, would be done only very slowly.

In the second case, all the electrical energy will be converted into low-temperature heat, which will be transmitted straight to the air in the room; the furniture and walls will be in time warmed from the air—just the reverse process from that described above.

Now for some figures:—Take a room 18 ft. by 10 ft. by 8 ft. 6 in. high. This will contain about 120 lb. of air and, say, 500 lb. of furniture. The brickwork in the walls, assuming 4½ in. on two sides and 4½ in. to a cavity on the other two, would weigh about 20,000 lb., and a one-inch wooden floor and ceiling 1,300 lb. The specific heat of air is 0.24, brick 0.2, and wood 0.6. So that the air takes 29 B.th.u. to raise it one degree Fahrenheit, the furniture 300, and the walls, &c., 4,800.

The 1-kW radiator, allowing six changes of air per hour, would keep the air of the room 20° F. higher than outside, whilst it would take the same radiator 30 hours to raise the temperature of the walls and furniture by the same amount, even supposing that no heat was lost by cooling to the outside.

It is thus seen that if the warming of the air is the objective, it is much better to do it directly by a "convector" than indirectly by a "radiator." But there are some occasions when the radiant energy from a luminous type radiator is the more useful. Take, for instance, the case where an unfortunate child has to practise the piano for an hour a day in an otherwise unoccupied and therefore unheated room. It is equally out of the question, from the cost point of view, to attempt to heat either the walls or the air, but a 1-kW radiator will keep the child warm in an air temperature of 40° F. by being placed so that the direct radiant energy falls on her and warms her, without warming the air through which it passes. On the other hand, where it is intended to keep a building warm day and night throughout the winter, heating elements built into the (inside) walls have very much to recommend them.

Another point of view which it is important not to lose sight of is the psychological aspect. It is doubtful if one can *be* warm if one does not *feel* warm, and it is demonstrable that one can be made to feel warm without being warmed, *e.g.*, the Berry imitation coal fire.

Another example of local heating is the use of electric foot warmers. We have kept a bench full of girls warm and cheerful in an otherwise unwarmed room in winter by letting them rest their feet on a long wooden trough lined with slab asbestos and covered with tin containing one 8-c.p. carbon lamp per girl. Examples of local heating under the drawing boards in a drawing office have proved equally effective and economical.

An interesting problem connected with electric heating is given by the gasfilled lamp; why does a 60-watt gasfilled lamp, whilst receiving the same energy as a 60-watt vacuum and giving (a little) more light, apparently give more heat also? The answer is really very simple: it doesn't! The lamp itself undoubtedly gets hotter; no lamp uses more than a small part of the energy it receives for making light, much the larger part is wasted; the vacuum lamp sends its wasted energy out as non-luminous radiant energy, which does not heat the glass it passes through; the gasfilled lamp uses more of its wasted energy in making heat locally, partly because its filament is hotter, but mostly because it is surrounded by gas which conducts the heat to the glass and cap of the lamp. Put into an enclosed shade, the gasfilled lamp gets too hot, whilst the vacuum lamp can get its waste out through the glass shade to warm the outside universe.

Ice Formation at Hydro-Electric Plant.—A plan for heating the dams, valves, and gates of electricity generating plant slightly above freezing point in order to keep them free from ice was outlined before the International Joint Waterways Commission in session at Ottawa, Canada, in November last. A new type of turbine, which the Ontario Hydro-Electric Commission proposes to use in the scheme, was described by Mr. F. H. Rogers, a Philadelphia engineer. Mr. John Murphy, electrical engineer to the Railway Commission, said that in addition to heating the dams and gates, the machinery within the power plant also would be kept at a temperature above freezing point, thus eliminating any ice formation. The subject of heating was brought up after Mr. Hugh L. Cooper, of New York, had predicted that ice jams would prove a serious problem in working out power development schemes.—*Reuter's Trade Service* (Ottawa).

INDIA: BRITAIN'S GREATEST MARKET.

Official Report of the Situation.

H.M. Senior Trade Commissioner at Calcutta (Mr. T. M. Ainscough) in a report recently issued by the Department of Overseas Trade (H.M. Stationery Office, 5s.), and briefly referred to in our "Business Notices" last week, dwells upon the phenomenal trade activity which set in immediately after the armistice, the depression that followed when a world slump occurred in the raw materials market, and the ensuing deadlock in India's import trade. He records the developments in economic research and improvement of the natural resources of the country, surveys generally its industrial conditions, transport, communications, finance, and exchange, and finally submits some general suggestions regarding the probable trend of events.

First, it is worth noting that Mr. Ainscough favours the tendency towards direct trade between Indian importers and overseas suppliers, which has been one of the features of the past few years. In spite of unfortunate experiences with certain importers at the time of the recent crisis, he is convinced that direct trade, if carefully conducted on sound lines, and with responsible Indian firms, is reasonably safe, particularly in those cases where the home shipper has a resident representative in India to safeguard his interests. At the same time, Mr. Ainscough expresses the hope that British export houses will, in future, exercise greater discrimination in the granting of credit, and will, wherever practicable, appoint resident representatives to watch their interests.

Hydro-Electric Development.

The position of the four great Tata hydro-electric schemes is summarised in the report. Our Indian correspondent recently referred to this subject at length. The Hydro-electric Survey of India, which was inaugurated in 1918, has proceeded steadily with its work. Much additional power has been located and assessed, and it is hoped that in another three years or so the initial part of the work will be completed.

After a preliminary investigation the Hydro-Electric Survey estimates that there are about 1¾ million electric horse-power actually in sight in India, but *this is, of course, vastly below the actual available power which the final results of the survey will disclose.* Moreover, the great perennial snow-fed rivers have been scarcely touched upon, and their potential power has not been determined. The following is an approximate estimate of the power of all kinds in use in India in 1919:—

Province.	Brake Horse-power.
Assam	22,550
Bengal	25,318 exclusive of Calcutta area.
Calcutta area	176,200
Bihar	2,325 apart from collieries, &c.
Bombay Presidency ...	32,872
Bombay City area ...	750,000
Burma	17,750 exclusive of rice mills, &c.
Central Provinces ...	32,773
Madras	39,568
North-West Frontier Province	—
Punjab	15,734 steam only
United Provinces ...	38,548
Total	1,153,638

Mr. Ainscough quotes as follows from the final paragraph of the preliminary report: "While this work is being carried out the interlaced question of industries is in strong hands, and the combination of power and industries is essential to the prosperity of both. . . . There will be keen competition in the market for orders, and British manufacturers of pipes, turbines, generators and switchgear must see to it that they are not left stranded. Hitherto they have been content to take the small orders and to let the large go to countries that have specialised in water power. It has even been asserted that engineers from abroad are essential to the proper erection of plants when received. It is high time that these fallacies should be disproved."

These strictures are rather severe, but Mr. Ainscough very fairly adds that since they were written British makers of water power plant have made very great strides. "Water turbines of the largest size are now being made by two or three large firms in England. The hydraulic gear has always been a speciality of British makers, while the large British groups can manufacture generating sets as cheaply and well as any of their foreign competitors. It is only in extra high-tension equipment that they have hitherto not had much experience, but even here a determined effort has been made to manufacture apparatus even for the largest schemes."

The story of the iron and steel industry of India is largely the record of the Tata Iron & Steel Co., Ltd. Its progress is well known. Regarding the subsidiary industries which it was hoped to establish in the vicinity of Jamshedpur, the completion, and in some cases even the further consideration of these projects have been delayed, chiefly owing to difficulties in obtaining capital. The company is, however, still negotiating for the establishment of plants for the manufacture of railway wagons and locomotives, agricultural implements, wire products, tin plates, enamelled ironware, cables, and special steel for reinforcement.

Local and Other Competition.

The competition of Indian industries calls for serious consideration. Last year the demand for steel was so great that British shipments increased enormously, and the competition of the Tata steelworks, says Mr. Ainscough, was not realised. When the extensions to Jamshedpur are completed the production available will, however, be 425,000 tons of finished steel per annum. It is expected to work up to this production in four years' time. In addition, iron castings will be produced in steadily increasing quantities, both at Barakar and at the new Indian Iron and Steel Company's works at Asansol. The two large new projects for iron and steel works are still in the preliminary stage, but there would appear to be little doubt but that the schemes will be proceeded with, in which case, in the course of the next five to ten years, we shall see at least three steel works in India of the size of the Tata concern. Competition in steel bars, billets, plates and sections of all kinds will rapidly and steadily increase, and it must always be remembered that, whether a protective tariff is or is not imposed, Indian manufacturers always have a most substantial natural protection in the costs of freight and handling between the United Kingdom works and the market. The engineering shops in India are competing more and more in structural steelwork and simple steam engines of all kinds. The supply of steel on the spot in the shape of plates and sections will tend to stimulate this competition. Hitherto, most of the wagon-building in India has merely consisted of assembling parts and sections imported from home, but with a steel supply at their doors local engineers are bound to become more ambitious. Jute mill machinery will shortly be produced at Jamshedpur and tea machinery at Agarpara, near Calcutta. There are also several works near Calcutta which are engaged on the manufacture of the essential parts and stores used in jute mills, and a number of jute looms have already been turned out.

The largest number of engineering workshops (including iron and brass foundries and shipbuilding works) is in Bengal (74 factories with 15,840 persons). Other important provinces stand thus in order of importance: Bombay (20 factories with 5,387 persons), Bihar and Orissa (7 factories with 5,278 persons), the United Provinces (7 factories with 1,610 operatives), and Madras (9 factories with 1,394 persons). There are two iron and steel producing works, one in Bihar and Orissa employing 10,775 persons, and the other in Bengal with 6,370 operatives.

Whilst buyers in India say that they can obtain earlier deliveries and greater consideration from German manufacturers, there is the great handicap when purchasing machinery and plant from Germany, that it cannot be erected by German mechanics in the employ of the manufacturers owing to the Government of India Act excluding German subjects from residing in India except under special licence for five years after the conclusion of peace.

Japan's trade in India during the war in electrical accessories and implements is cited as one in which she could never hope to compete in normal times.

Mr. Ainscough deals at length with the much-debated question of the purchase of Government stores, and gives *in extenso* the proposed rules for the supply of articles for the public service.

The Institution of Engineers (India).

Before leaving the subject of industrial developments in India mention is made of the inauguration of the Institution of Engineers (India) in February, 1921. It had been felt for some time that there was a growing need in India for an institution combining the civil, mechanical and electrical branches of the engineering profession. While it is true that most engineers in the country belong to one or another of the home institutions, it was found to be very difficult, with such a scattered European population and such great distances, to work successfully local branches of the home institutions so as to make them really influential bodies. Thanks to the energy and enterprise of one or two enthusiasts, ably backed by Sir Thomas Holland and the Board of Industries, a central Indian institution has now been successfully launched.

Prospects for Branch Works.

On the subject of the erection of branch factories in India, a short recapitulation of the Trade Commissioner's conclusions may be of advantage. Of cement, heavy castings, pipes, and tubes and certain types of constructional steelwork, prospects for local manufacture should be promising, because the principal raw materials are available in India, and that country affords a large steady

market for them all. Certain established industries in India require constant supplies of machinery and parts which might be worth manufacturing on the spot. Amongst them may be mentioned cotton and jute mill machinery, tea and rubber machinery, agricultural and hand tools. When it comes to heavier plant, *e.g.*, locomotives, wagons, waterworks equipment, and small pumps, local manufacture might be successful, subject in some instances to the importation of certain parts which involve the application of highly skilled labour. An important consideration throughout is that if British manufacturers do not take advantage of such opportunities as India presents, our foreign competitors may do so, and thereby undersell our imported goods in the market. Further, protectionist feeling is running very strong in India. If and when such a tariff is imposed, the whole question of establishing branch works in India must be reviewed from an entirely fresh angle of vision, and manufacturers in many cases may find it to be more advantageous to produce within the tariff wall than without it. On the other hand, British firms have certainly had some discouraging experiences. Monetary stringency, difficulty in securing skilled labour, the growing unrest and general shortage of labour, and finally the disinclination of the Indian Government to guarantee to purchase a certain proportion of the output—all these factors have stood in the way of a successful launching of branch works in India.

Electrical Imports.

During the past year imports of British machinery generally not only expanded by over eleven millions sterling in value, but the percentage share has advanced to 78 per cent. of the total. It is highly satisfactory to be able to note that the United Kingdom regained her position as the principal supplier of electrical machinery, her shipments being valued at £1,490,473, as compared with £665,843 from the United States. In commenting on the statistics of imports of electrical apparatus and appliances (which were published in some detail in a recent issue of the Electrical Review), Mr. Ainscough points out that in the five years preceding the war the United Kingdom supplied 82 per cent., the United States 6 per cent., and Japan 4 per cent. Last year the respective shares were: the United Kingdom 69 per cent., the United States 20 per cent., Japan 3 per cent., Holland and Italy each about 2 per cent. During the war the large trade in ceiling and desk fans was practically shared by the United States and Italy, with the United Kingdom a bad third. This position is now largely reversed, and although the Americans still head the list, the margin over the British imports is reduced to very little. In electric wires and cables, the British lead is still further established, although American and Japanese shipments, notably of bare copper wire, have increased enormously. The most important item is rubber insulated cable, of which the United Kingdom supplied 90 per cent., the United States 7 per cent., and Japan 2 per cent. As regards insulations other than rubber, 96 per cent. came from the United Kingdom and 2¼ per cent. from Japan. The United Kingdom supplied virtually the whole of the telegraph and telephone wires and cables. Apart from copper wire, Japanese imports of cables are negligible. The strong British position in the cable trade is almost entirely due to the excellent organisation and activities of the Indian branches of the leading British cable makers. In lamps, too, the British position has improved. Imports of Dutch make have been largely replaced by British lamps, and the United Kingdom now supplies 55 per cent. of the total trade, Holland 28 per cent., the United States 5 per cent., and Japan 4 per cent. Again, British makers are successfully withstanding American competition in accumulators, batteries, telegraph and telephone instruments, lighting accessories and fittings, and meters. Mr. Ainscough mentions two minor lines in which there is room for development, viz., electro-medical apparatus and electrical porcelain. The report pays a tribute to the branches and agents in India of the leading British makers to whose sound organisation and active salesmanship a very great deal of the splendid recovery made is due. The electrical trade, both as regards machinery and apparatus, fittings, &c., may be regarded as a model from the point of view of representation. Almost all the leading makers have their own branches in India staffed with both technical and commercial men, and where this is not the case, the agency is entrusted to a local merchant house, who can provide a similar organisation. The figures and particulars given are sufficient proof of the value and efficiency of this system.

THE DESIGN OF LIQUID RHEOSTATS.

By W. WILSON, B.E., M.Sc., A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers at Birmingham.)

The liquid rheostat is playing an increasingly important part in the operation of a.c. motors of large capacity. The smoothness of its control; its robustness, amounting almost to indestructibility; the facility with which its resistance can be varied within wide limits by modifying the strength of the electrolyte; its cheapness and ease of construction, &c., combine to render it a valuable piece of equipment. To-day, when motors of ever-increasing capacity are being used in heavy industries, dependent almost without exception on this type of rheostat for their control, its design is becoming more and more important. The author's object, therefore, in presenting the paper is the more definite determination of the constants of the liquid rheostat and the more exact prediction of its performance.

The various phenomena that take place when a current is passed through an electrolyte are:—

(1) *Thermal.*—The effect of the generation of heat is ebullition, the harmful effects of which disappear when the temperature falls again. The quantity of heat produced in a liquid varies with the number of watts dissipated. Thus the rise in temperature is dependent, not only on the current flowing, but also on the fall of potential between the electrodes.

2. *Chemical.*—The chemical effect varies with the current only, and the practical results, as far as rheostats are concerned, are as follows:—

(*a*) The electrolyte itself is decomposed, so that in general it deteriorates with use. (*b*) The anode is eaten away. In most instances met with in practice both anode and liquid undergo more or less serious deterioration when in active use with direct current. (*c*) Gas is generally given off at the plates, depending partly on the density of the current per unit area of electrode, usually derived from the decomposition of water, and bubbles of hydrogen predominate. When gassing is excessive, one bubble may extend from plate to plate, and spontaneous ignition, or an explosion on a small scale, is then possible. If the production of gas is permitted to increase, large bubbles eventually set up a sub-aqueous arc between the plates, and thus form practically a dead short-circuit across the rheostat.

An objection to solutions of common salt for use in rheostats is that chlorine may be given off in sufficient quantity to endanger human life. The gases from sulphuric acid electrolytes are also objectionable.

All electrolytic phenomena are unidirectional, *i.e.*, they are reversed if the direction of the current reverses. Hence the effects of electrolysis are negligible with alternating current under ordinary conditions. Even when electrolysis is absent, a certain small amount of chemical action occurs between the plates and the liquid, chiefly of the nature of rusting. In nearly every practical apparatus, iron electrodes are employed, and one of the following electrolytes: sodium carbonate (washing soda), sodium chloride (common salt), or sodium hydrate (caustic soda). The second has by far the greatest corrosive effect upon the iron, and the other two are therefore preferable, but these have the property of disintegrating almost all plastic insulators such as varnish, cement, wax, &c., and they also exercise a deteriorating effect upon pottery. Most standard designs, however, do not suffer to any serious extent from corrosion by the carbonate or hydrate.

3. *Other phenomena.*—No new phenomena apart from those mentioned in sections 1 and 2 were observed. With a liquid resistance the limiting conditions are not simple, for all the phenomena mentioned in 1 and 2 above contribute towards the restriction of duty of a given apparatus. Thus it is not possible to lay down a general rule that in every case the curent density must be of a certain value, or the total watts absorbed so much.

It can be safely concluded that at high alternating-current densities, *i.e.*, up to 4,750 amperes per sq. ft., there is no appreciable amount of electrolysis or other phenomenon than that of the production of heat. The above does not suggest that electrolysis does not take place to a considerably greater extent than is indicated by the tests, but shows that the ultimate effects are negligible in practice.

The conditions were modified to introduce a high voltage gradient, *i.e.*, 2,400 volts per in. Large bubbles of steam were produced by the 8.4 kW acting on the small volume of liquid between the plates; but although the power was supplied for some time, there was no sign of breakdown, and the closest inspection failed to reveal any arcing or other troublesome phenomenon. A small proportion of the bubbles evolved reached the surface of the liquid, and their amount was increased by reducing the separation of the plates. This explosive gas was due to the electrolytic decomposition of water, but the extent of the action was still far from being serious. In addition, the electrolytes employed in practice very rarely consist of other than alkaline solutions.

A further test bearing upon the ultimate capacity was carried out to search for any surface effect of the nature of "surface contact resistance," but the result shows almost conclusively that there is no surface effect.

Thus it has been established that with alternating current electrolytic effects are negligible and that all the resistance is due to the electrolyte. The first of these facts simplifies the problem of designing a liquid rheostat for use with alternating currents, for it proves that the evolution of heat is the only phenomenon to be reckoned with. Given the necessary facilities for the removal of the latter, current densities can be employed at least of the order of from 4,000 to 5,000 amperes per sq. ft., and probably higher if it should prove desirable.

Some of the above conclusions were confirmed by tests upon larger apparatus, using much higher voltages and powers, which finally dispose of the alleged surface effect, as far as the conditions of the commercial liquid rheostat are concerned. There is no doubt, however, as to the existence of a high surface resistance under special circumstances, such as those sometimes encountered when temporary rheostats are set up for the testing of large generators. For this purpose, small electrodes are partly immersed in plain water. The portions below the surface of the liquid are apparently surrounded by a "blanket" of steam which, owing to poor circulation, is not readily dissipated. It is not certain to what causes this "blanketing" is due. A potential of the order of 5,000 volts is one of the conditions of such tests, and the trouble seems to disappear at lower pressures. But such conditions are not encountered in the case of the apparatus described in this paper; nevertheless, confusion has been caused in the past through designers generalising on the strength of such results.

No limit for current density has yet been found. The cause of such breakdowns as have occurred within the author's knowledge has been arcing between electrodes due to the temporary removal of a portion of the electrolyte by the formation of gas, accompanied by an explosion of a large bubble of mixed gas, or of two large adjacent individual bubbles. It is conceivable that frothing, due to an insufficient supply of cool electrolyte, might provide means for the overheating of the liquid "conductor" in the case of an alternating-current rheostat, if the voltage gradient across the space between the electrodes were sufficient.

A test to study the modifications introduced by gassing was carried out by direct current representing 5,760 amperes per sq. ft. The result was the evolution of large volumes of gas from both electrodes, which rose to the surface in fairly small bubbles, and was apparently not capable of causing arcing or other breakdown. It appears certain that the mere presence of the gas is not sufficient to cause failure at the high current density employed, but that a high temperature, a dirty or stagnant electrolyte, or other additional agency, is necessary to facilitate the evolution of large bubbles, and consequent arcing. The conclusion appears inevitable, that, given a sufficiently plentiful stream of electrolyte at a temperature well within the specified working limits, current densities up to 4,500 amperes per sq. ft. are practicable, even with direct current. At least one type of rheostat complies with these conditions.

[The author next deals with the design of self-cooled liquid starters for motors of small and moderate sizes, and calculates the rating for infrequent duty. His calculations, when compared with the rating of the majority of starters in practical use, permit the carrying out of much heavier work than is the custom at present. He also accurately predicts the manner in which a starter will heat up for periodic duty, and from the data thus obtained, obtains by calculation a complete prediction of the performance. The calculation is deduced from first principles, and enables the performance to be readily predicted when the dimensions have been fixed according to the ordinary units employed in this country. A more mathematical treatment, which makes provision for a variation in the emissivity follows; it is analogous to Helmholtz's equation for the growth and decay of an electric current in an inductive circuit. It is suggested that a definite means of increasing the duty of a given rheostat would be to corrugate or rib the surface of the tank.]

With regard to larger self-cooled liquid rheostats, vitrified earthenware pots are very commonly used to separate the phases, but are not always satisfactory owing to breakage due to heating applied to the inside only, or to heat expansion against the clamping of a rigid watertight joint. A certain amount of deterioration is caused, in addition, by chemical action on some species of earthenware. For the above reasons, treated wood has been substituted in an American design.

As the size increases, natural cooling of the starter becomes more difficult, since the heat developed is proportional to the cube of a given dimension, while the surface is only proportional to the square. For regulators and controllers which are required to be in circuit continuously, unaided cooling is almost impossible, except for the smallest capacities.

Liquid rheostats for increasing the slip of induction motors have been in use for quite a long time, primarily in connection with the Ilgner system, but it is doubtful whether their performance renders them preferable to a permanently-connected resistance, with its continual heavy waste of energy. The principal objections to the present design of rheostat are: (*a*) *Unreliability*, chiefly through metallic corrosion and the breakage of pots; (*b*) *sluggishness of action*. If there is any appreciable delay, *e.g.*, the 1 or 1½ second which has been met with in practice, the full peak current, at least in the case of a rolling-mill load with its very rapid acceleration, will come on the line and will merely be curtailed in duration by the operation of the rheostat. Thus the apparatus will have failed to justify the expenditure incurred in its installation and maintenance.

Spring control, preferably by the extension of a helical spring or springs, is suggested. Its effect upon the loading of the induction motor would be that a certain fraction of the overload would be taken by the motor, as an overload is necessary to maintain the deflection of the torque motor. Another method of realising the attainment of equilibrium without delaying its inception is by damping the movement of the dippers, already available in the "dash-pot" effect of nearly disk-shaped dippers moving through the liquid in a direction normal to their faces. The designer will have to choose between the two alternatives described above and a combination of both, according to the nature of the problem. For example, it would be fatal to throw all the overload upon the flywheel if the latter were not large enough to supply the whole peak. The usual design suffers through over-complication. A slip-regulator is a short-circuiting, and not a "straight-through" rheostat, hence there is no need for the phases to be insulated from one another. Thus at the outset the porcelain pots would appear unnecessary, and this is important in that much unreliability in the past has been due to their presence. Their insulating effect is neutralised by increasing the conductivity of the electrolyte, with the result that corrosion problems are accentuated. The design of a slip-regulator on simpler lines is possible. Such a rheostat would possess three or more fixed electrodes, which by themselves would interpose the full slip-resistance. A single moving electrode would approach them, and would reduce the resistance to a practical short-circuit.

A Continental slip-regulator does not contain porcelain pots, but the moving electrodes rotate, and the torque motor is geared to the rheostat shaft by means of a chain. This pattern is designed on more rational principles, as it does not incorporate the conflicting and troublesome features described above. If the simplifications indicated are carried out, inertia and corrosion are reduced and immersed insulators obviated. Thus the principal faults can be practically removed.

One or two examples of the liquid rheostat present unusual features, or indicate possibilities of extension in its use. An especially interesting example is the "counter cell" employed in connection with the constant-potential method of charging lead batteries. Use is made of lead-sulphuric acid-lead units, in which the lead plates are not "formed" in any way, and the cells simply function as though they were lead batteries perpetually undergoing overcharge. Each one thus interposes a constant negative potential, and decreases the effective charging voltage by a corresponding amount.

The design of these liquid resistances, as far as spacing and current density are concerned, may be deduced from that of the lead accumulator. The principle underlying their use is one which should render them serviceable in other branches of work, and it has been employed by the author for continuous and unattended work in connection with direct-current organ-blowing motors. Its function is to start and then regulate the motor in such a way that the level of the bellows is constant whatever the demand for wind. Its operation is quite automatic, the releasing of a catch being alone required to put the apparatus in full commission. Tap water alone is used as the electrolyte, artificial cooling, when required, being brought about by passing automatically a small trickle of water through the tank when the outfit is in use, an expedient which also keeps the electrolyte clean. The electrodes were of sheet lead, in the form of a lining to the wooden tank, and a short cylinder respectively. The depth of water was from 4 to 6 in., and the moving electrode just grazed the surface when the bellows were full, but rested on the bottom of the tank when they were about two-thirds empty. The outstanding smoothness of acceleration given by the liquid rheostat was a valuable feature, in addition to the absence of arcing.

By employing the results of the tests and calculations described in the original paper, it is possible to design a liquid rheostat to give exactly the desired performance, and there is no reason why advantage should not be taken of this to render the apparatus as compact and inexpensive as the data will permit. In the past, extravagant standards have been employed. A much smaller factor of safety is appropriate with liquid than with solid resistances, a point of especial importance in the design of self-cooled apparatus. A specification permitting a working range of 120 deg. F. for certain of the smaller types of rheostats would be justifiable, but, if the present standard of 100 deg. F. is adhered to, the designer has in hand a considerable margin of safety to provide against improper use. It should be remembered also that the starter is only required to dissipate an average of about half the power passing through it during the period of starting. This point is emphasised, as many starters have been designed in the past on the assumption that they absorbed the whole of the energy at starting.

It is a common practice to require wire rheostats to effect an endless succession of periodic starts. This method of rating is not appropriate for liquid starters. A more suitable requirement would be the carrying out of a given number of successive starts, followed by a sufficient interval to enable the liquid to return to practically its normal temperature. It is impracticable to compile a specification to satisfy all the duties that may be required in practice. A compromise is therefore necessary, and it would be unfair to expect two dissimilar appliances to comply with exactly the same conditions.

No motor for which a liquid starter is used is ordinarily started up every 15 minutes or so throughout the day. If it were required to do so habitually, either an artificially-cooled liquid starter, or one designed for a larger capacity, or a solid pattern of rheostat, should be employed. At the worst, nothing more serious can happen than a slight amount of boiling near the conclusion of the later operations.

The author has endeavoured to show that the liquid rheostat is readily capable of mathematical design, enabling its performance to be exactly predetermined. It is his contention that advantage should be taken of this fact to fix the dimensions in close correspondence with the desired result, a reasonable margin only being allowed for contingencies.

Discussion.

Mr. J. Anderson said the paper was useful on account of the new data brought forward, but in practice the ideal was far from being realised. Rider's tests assumed it was necessary to have an open position at "off" by withdrawing the dippers, but that seemed the worst way to use a liquid starter; it was simply asking for trouble, and liquid starters should always be interlocked with the breaker to ensure opening the circuit with the breaker and closing the circuit with the dippers in the right position for the desired initial current. Even interlocking was not a cure, as the level of the liquid might be allowed to fall too low, and as the dippers and solution required changing from time to time by the attendant, there could be no guarantee that they were not altered on site and the starter overloaded or the motor unduly stressed. The author's tests showing little corrosion with 25-cycle supply did not agree with a test made some two or three years ago by the speaker. A resistance element consisting of a porcelain cylinder wound with alloy resistance wire about No. 20 gauge was immersed in Birmingham tap water, and after a 25-cycle current had been passed through it for two hours the wire had rotted through and broken the circuit; speaking from memory, the potential between the ends of the cylinders was 100 volts. The d.c. corrosion was generally heavy, and the average life of cast-iron electrodes in haulages was not more than six months, so that a starter in frequent use must have ample facilities for changing the electrodes and the solution and clearing out sludge. Total enclosure to meet the Mining Rules was not easy with small horse-powers. The decrease of resistance with temperature must be troublesome and fatal to exact work. A soda solution did not freeze easily, but the possibility must be remembered if the starter was in an exposed position. The author rightly referred to the iniquities of standard specifications, and it was a criminal waste of material to try to dissipate energy with a temperature rise of 100 deg. F., and to throw away the possibility of utilising the latent heat of the steam generated by short-rated starters.

Mr. H. C. Fox said the fact that the tests did not establish that with alternating current of any periodicity electrolytic action was negligible was of importance when the rheostat was in series with the rotor circuit of a lightly loaded induction motor. In such a case the frequency was of the order of one or two cycles per second unless the resistance value was very high, and in such circumstances a certain amount of electrolytic action might be anticipated as d.c. conditions were being approached. The author had assumed that the average h.p. dissipated during starting was 50 per cent. of the continuous h.p. of the motor when taking a current equal to that passed during the starting period. Since the resistance-time curve must be parabolic if the current was to remain constant during starting, it followed that the h.p. to be dissipated must be 66 per cent., not 50 per cent. That, of course, meant that the starter for a given motor would have to be 33 per cent. larger than the author's figures would give. The increased rating that would be obtained by ribbing the tank would not be worth the trouble; ribbing had much less effect than was commonly supposed.

Mr. C. Sutton said that the paper would have served a very useful purpose if it convinced users that the liquid rheostat was a permanent article instead of only being of use in a test room. The author's principal criticisms of the stationary electrode type of rheostat seemed to be (1) a large pump was required to fill the electrode tanks quickly when a high rate of acceleration was required, and (2) mechanical force was required to operate the weirs. The speaker's tests of two resistances coupled together, one pump supplying the electrolyte for both and one hand wheel operating all the weirs, showed that the pump took 2 h.p. and filled the electrode chambers in less than ten seconds—less than one per cent. of the continuous capacity of the rheostat. The handwheel operating the weirs was also coupled to a shunt regulator on the switchboard, and no appreciable power was required to turn the handwheel. Stated shortly, the advantages seemed to be: 1. Compactness. 2. Ease of working and small moving parts. 3. Flexibility; the shape of the resistance curve could be varied over a wide range. 4. Ease of renewals; any electrode could be replaced in a few seconds. 5. Efficient cooling; all electrolyte came into direct contact with the cooling pipes and at a high speed. 6. The cooling pipes were straight and could be withdrawn very easily. 7. The apparatus was totally enclosed, with the exception of a vent pipe.

Mr. B. A. M. Boyce had figures which showed that the standard type of liquid rheostat was a reliable piece of apparatus. The company he was connected with had supplied to one client 262 starters during the last seven years, during which time the spare parts ordered had been four sets of contacts and nine sets of dippers. Assuming the whole of the 262 starters to have been in use for three years, gave a total of 786 starter-years, and the spares would be stated as 0.51 sets of contracts per 100 starter-years, and 1.15 sets of dippers per 100 starter-years. With regard to current density in the electrodes, it should be borne in mind that the density given in pocket books with full immersion would most likely be exceeded considerably when the electrodes were only partially immersed. He thought there was a critical frequency between 25 and 40 cycles, and that below that critical point the effects of alternating and direct current were similar.

Prof. W. Cramp referred to the use of "plain water"—a very hazy term, as water in different localities varied widely in its behaviour as an electrolyte. He did not agree that the author's fig. 4 proved the absence of the "surface effect," but merely that in a.c. circuits the surface effects neutralised one another; the line did not pass through zero as it undoubtedly should if all surface effects were absent. Throughout the paper the bases for the calculation of the surface densities were unsatisfactory, for the protection of the backs of the plates with insulation did not mean that there would be no current therefrom.

Mr. T. Simmons, in a communication, did not consider liquid rheostats very adaptable for controlling motors driving main and tail drum haulages where the stops and starts were very frequent. He had in mind a 30-h.p. haulage set working underground; the interval between each start would not be more than from four to five minutes, and the motor had to start up with full load torque. Under those conditions the electrolyte evaporated rather quickly, and one could not depend upon a motor attendant to fill the container with electrolyte of the correct strength. That was where the trouble commenced. Where Rule 132 of the Electricity in Mines Regulations was in force, it would be impossible to comply with it by using a liquid rheostat. When the electrodes made or broke contact with the electrolyte, a spark was always present. Was there any reason why the electrodes should leave the electrolyte? Some wire-wound rotor starters were designed so that the motor started up when the line switch was closed—a design which might be applied to liquid starters. To stop the motor it was only necessary to open the line switch, but provision would have to be made to interlock the main switch with the starter, so that the line switch could not be closed with the starter in the "full on" position.

AERO ENGINE IGNITION.

(*Continued from page 692.*)

Spark Intensification.—The second report, No. 17, August, 1917 (I.C.E. 135), is by Dr. G. E. Bairsto, and was presented by the superintendent of the Royal Aircraft Factory; it is concerned with the intensification of the spark of a defective spark plug by the use of an additional spark gap in series with the plug.

The presence of oil on spark plug points may produce two effects: It may (1) cling to the sparking points and insulate the gap, thereby causing misfiring; (2) become carbonised and deposited on the surface of the insulation, causing short-

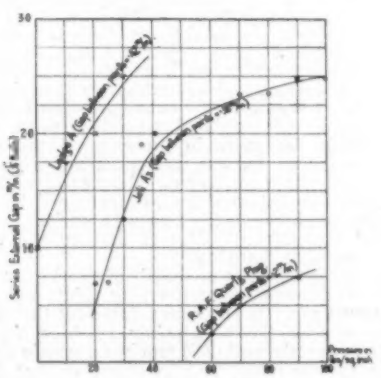


Fig. 2.

circuiting of the current across the insulation instead of across the spark points. The use of an additional spark gap in series with the plug has been advocated as a means of preventing this misfiring, and the following tests were made to determine the precise effect of the additional gap.

A number of defective plugs were tested under air pressure with an adjustable air gap (¼ in. balls) in series. The air pressure was varied and the series gap adjusted to give regular

firing (if possible) on the plug points. A Bosch hand starter driven at a constant speed of 1,200 r.p.m. was used as the source of h.p. current.

The results indicated that the spark gap necessary for regular firing is very variable and depends very much on the value of the air pressure and on the magnitude of the gap between the sparking plug points. Fig. 2 shows graphically the results for three different plugs. The external spark gap for regular firing increases with increase of pressure, and is largest in the case where the spark plug gap is largest. The spark gaps given above are the minimum ones to just create regular firing. Actually the plug will give regular firing with still larger external gaps. This is illustrated by fig. 3. There is an upper limit, however, beyond which, if the gap is opened up any more, misfiring begins to take place.

During tests on new plugs, the surface insulation of which had been artificially carbonised, it was shown that it is much easier to produce a *continuous* conducting layer on a mica plug with its rough surface than on the smoother surface of a porcelain plug. With regard to tests on new plugs shunted with an artificial leak, the general nature of the curves of the results obtained from three different plugs, each shunted with a water resistance of 10,000 ohms, is similar to that of the curves in fig. 2, *i.e.*, the higher the air pressure, the larger is the external gap necessary for regular firing, and also the plug with the widest gap requires the largest external gap. There is one point of difference, however; at low pressures the external gap becomes practically constant, whereas in fig. 2 it rapidly decreases to practically nothing. This would seem to be explained by the surface resistance of the carbonised insulation differing considerably with the varying conditions of voltage and current. Attempts were made to measure the resistance of a hot carbonised plug by means of an ordinary Wheatstone bridge, but in every case it was of

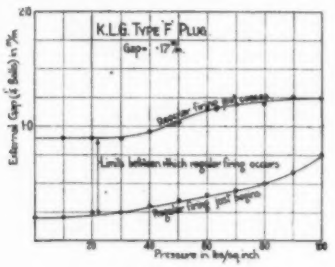


Fig. 3.

the order of 1—10 megohms, which is too high to have much effect on the firing of the plug. When under a very high voltage it undoubtedly falls to a much smaller figure owing to minute arcing from particle to particle.

In another set of measurements a given plug (gap=0.17 mm.) was shunted with various resistances from 1,000 to 1,000,000 ohms, the higher one being obtained by means of a graphite resistance made with a soft carbon pencil line and the lower one by means of a water resistance. The external gap was plotted to air pressure, and it was shown that for any given resistance the external gap requisite for regular firing increases with the pressure. At any given pressure the gap rapidly increases as the leakage increases. When the leakage is very great, however, the firing becomes irregular again.

In explanation of these effects, it must be understood that the total energy of the transient wave of electromotive force which fires the plug is very limited in amount, and if the plug is leaky in the electrical sense, the e.m.f. at the points may never reach a value sufficiently high to spark across them. Inserting another spark-gap in series with the plug prevents this leakage, and the secondary is enabled to build up the e.m.f. necessary for disruption. The length of this must be large enough for the plug points to reach the requisite potential before the spark in the external gap has passed, because when once the external spark has passed, the gap becomes practically a conductor. The way in which the total e.m.f. divides up between the two gaps will be a function of the capacities between the two gaps and of the capacities to earth of the different sides of the gap and also of the resistance shunting the plug.

Increase of air pressure or length of spark-plug gap means a greater e.m.f. necessary at the plug points and therefore a larger external gap. It has been pointed out that the external spark gap ensures the plug points reaching the necessary potential for breakdown, but it requires a certain time interval even then for the spark to take place, so that during that interval it is quite possible for the e.m.f. to fall (*via* the leak) before the spark has passed. Hence if the leak is large we need a bigger e.m.f. across the plug points than if it were not leaky, and this in turn requires a larger external gap. So at a constant pressure, the necessary external gap increases with the leakage.

Another factor is high-frequency currents that are set up when the spark takes place in the local circuit composed of the plug, external gap, and cable. The precise effect of these currents depends upon the capacity and inductance constants of the various parts of the circuit, and in one case that arose during the tests very peculiar results were obtained which could only be explained by the presence of these oscillating currents. It was found that there was a particular range of resistance shunting the plug for which the external gap was a maximum, and above and *below* this resistance the gap decreased. The matter could not be studied any further, as the committee had no wavemeter for recording these high-frequency currents.

Engine Starting.—A third report, No. 3, April, 1917 (I.C.E. 73), was presented by the superintendent of the Royal Aircraft Factory. This points out that owing to the greatly increasing size of the engines used for aircraft, the present generally used method of starting the engine by means of turning the airscrew is inefficient, and it is imperative that some mechanical means of starting be developed.

With the medium-power engine (100-150 h.p.) a fairly easy start can be obtained by means of the magneto hand starter, *provided the cylinders are first charged with an explosive mixture.* It is the uncertainty of the latter requirement which is responsible for most of the failures to start which have been experienced.

Some tests were made with coal gas on a R.A.F.4 engine fitted with a light flywheel, and it was found possible to start the engine on the starting magneto without swinging the propeller, and run on coal gas alone. However, it was not found possible to start a 250-h.p. Rolls Royce engine by the same method, and it was considered that the results were sufficiently conclusive to condemn this method of starting.

Starting an engine by compressed air would appear to be the most satisfactory method to be adopted, and a complete starting unit could be fitted to any aeronautical engine up to 300 h.p. at a total weight not exceeding 10 lb. including the distributor, pipes, and adaptors for cylinders, but not the air reservoir. Compressed air starting is in fairly general use in naval aeroplanes.

Electrical starting is not possible owing to the excessive weight of the plant required. Messrs. C. A. Vandervell and Co. have designed a power unit which will turn a 120-h.p. Beardmore engine at 156 r.p.m. for two minutes. Although this unit weighs 84 lb., it is considered to be very light for the work required.

Although it is considered that a satisfactory method of starting an engine by means of explosive cartridges could be evolved, it is probable that the resulting weight, owing to the need for large area pipes and distributing valves, would be excessive.

(*To be continued.*)

THE FARADAY SOCIETY.

Catalysis and Theories of Chemical Action.

The meeting of the Faraday Society held on September 28th was devoted to the discussion of the above subject. The Society was fortunate in securing the presence of Prof. Jean Perrin, of Paris, and Dr. Irvine Langmuir, the distinguished chief research chemist of the General Electric Co. of America, to take prominent parts in the proceedings, which were held in the hall of the Institution of Electrical Engineers, and attended by a large audience.

The subject under discussion naturally divided itself into two sections. The first, which occupied the afternoon session, was concerned with catalysis in homogeneous media—those consisting of one-phase, such as solutions or gases—and it practically amounted to a full-dress debate on the radiation hypothesis of chemical actions, first put forward by Prof. Perrin, and applied to include catalytic action by Prof. W. C. McC. Lewis, who also took a prominent part in the discussions.

When a unimolecular chemical reaction takes place, for example, the conversion of ozone into oxygen, it is generally agreed that the reaction is started by certain active molecules. In the case of a catalytic action, it may be that one or other of the "intermediate" compounds formed (if such are formed) acts as the activating agent. In any case the law of mass action so fruitful in explaining most cases of chemical kinetics is found not to be applicable here, and the question arises, whence comes the energy which "activates" these active molecules, and how is it communicated to the reactant unit? The radiation theory postulates the internal energy of the system, operating through radiation, to be the source of this activating energy, and its operation is explained and rendered quantitative by applying the conceptions of the quantum theory of radiation, which it will be remembered conceives molecular or atomic radiation to be emitted not continuously but intermittently in definite units of energy called quanta. This conception introduces into the law of mass action an exponential expression containing a term E which is energy of activation per gram-molecule characteristic of the reaction, and from which, if known numerically by experiment, the particular active wave length concerned can be calculated. We cannot here pursue this side of the subject in detail; suffice it to say that in their full papers Profs. Perrin and Lewis brought forward many examples where applications of the theory gave satisfactory numerical results. Nevertheless,

in the absence, at present, of crucial experimental evidence, the theory was subjected to some damaging criticism, especially by Dr. Langmuir, who regarded the exponential term in the amended law of mass action referred to above, not as testifying to radiation being the *cause* of chemical reactions, but merely as the *consequence* of what both of these have in common—namely, the quantum. The supporters of the theory, on the other hand, emphasised the fact that it is, after all, only an extension of photochemical action, the existence of which none can doubt. Much other more detailed criticism was put forward by Prof. F. A. Lindemann, among others, which was only met by *ad hoc* modifications of the original conception, and to a non-chemical outside observer the strong impression remained that while the theory has possibilities yet to be developed, and is likely to be fruitful in suggesting further experimental research, it cannot at present be accepted in any but a very tentative sense.

The evening discussion, opened in brilliant fashion by Dr. Langmuir, dealt with heterogeneous reactions and notably with surface catalytic actions which play so important a part in numerous industrial chemical processes. It was pointed out by Prof. W. A. Bone that the conceptions later developed in fuller detail by Dr. Langmuir were put forward by him independently long ago as a result of his well-known researches on surface combustion in its application to the more economical firing of boilers. The essential features of the way in which Dr. Langmuir pictures gas reactions on a surface which acts as catalytist—for example, the combination of hydrogen and oxygen or the oxidation of CO to CO_2 on a platinum surface—are: (1) The existence of very stable absorbed films on solid surfaces; and (2) the supposition that such films may consist of a *monomolecular layer*. Considerable evidence as to the existence of stable films was marshalled by Dr. Langmuir; principally from the example of the oxygen film on tungsten, but a similar stable oxygen film can also form on carbon, while carbon monoxide, hydrogen, cyanogen, hydrogen sulphide, phosphine, and arsine form films on platinum. Indeed, all substances that have a poisoning effect on catalytic surfaces probably form films of this kind.

These films are imagined to be oriented molecules in chemical combination with the surface—hence their stability. Primary valencies are involved in their formation. Thus, in the case of CO on platinum, the carbon atom is directly attached to the platinum, the oxygen projecting from the surface above the carbon. The surface of a catalyst may be looked upon as consisting of a kind of chess board in which some of the spaces are vacant, and others filled with atoms or molecules. Some of these are so firmly attached that they evaporate very slowly; others leave the surface from time to time, and the vacant spaces formed are filled by other molecules which strike and condense on the surface. If a film is formed that evaporates very slowly, the surface is no longer available for further condensations—the catalyst has, in fact, been "poisoned." It is clear that in some cases the adsorbed films will be extremely reactive, while in other cases they may be inert to outside influences, for the condensation of the gas molecules involves a rearrangement of their electrons, and the chemical properties may be completely modified. Thus oxygen adsorbed on platinum reacts readily with hydrogen or CO, while oxygen on tungsten or CO on platinum show little tendency to react with gases brought into contact with their surfaces. In many cases, especially where the molecules adsorbed are large (as they are, to quote an analogous example, in the case of lubricating oils) the orientation of the molecules on the surface is a vital factor in determining the activity of the surface towards reacting gases. The "activation" of a catalytic surface is similarly pictured as due to a geometrical rearrangement of the surface of the atoms due to the activating agent.

In a second paper Dr. Langmuir developed at length his theory of the mechanism of catalytic action as applied to the reactions $2\,CO + O_2 = 2\,CO_2$ and $2\,H_2 + O = 2\,H_2O$. In the former case the experimental results lead to the view that every oxygen atom which strikes a clean platinum surface condenses in the form of single atoms and combines firmly with separate platinum atoms, and even at 1,500 deg. (absolute) no oxygen evaporates. These adsorbed oxygen atoms are, however, very active and combine readily with every CO molecule striking the surface to form CO_2. On the other hand, CO molecules striking the platinum surface itself are not so firmly held (they evaporate at 500 deg.), and because of their orientation are inert towards oxygen. The second reaction is pictured on similar lines, and altogether the atomic conception put forward is greatly helpful in getting towards an understanding of the for long mysterious phenomena comprised in the word catalysis.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Wear of Bearings Alarm Device.

The Armature Winding Co., Ltd., of 44a, Bolton Street, Bury, Lancs., has developed a new device for giving warning when a bearing is worn to an undue extent, so that the disastrous consequences of letting it go too far may be avoided. The essence of the device, which is illustrated herewith, is

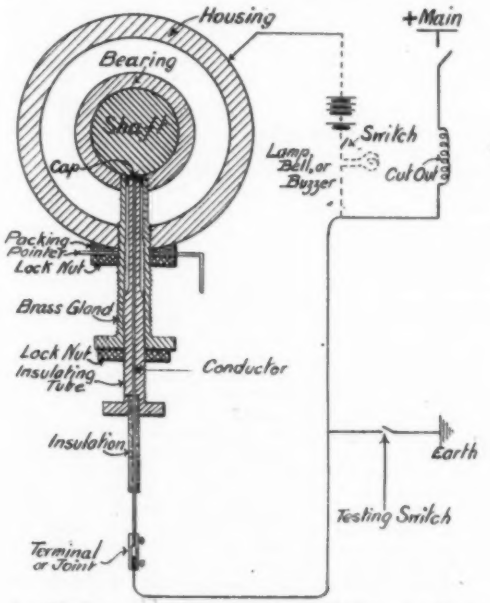


Fig. 1.—Section of Worn-bearing Indicator, in Position.

to insert in the bottom of the housing a wire, of which the end is covered with a thin insulating cap. As the burhing wears down, this cap wears down too, until eventually the wire makes contact with the journal and a local circuit is closed, lighting a lamp, ringing a bell, or, if desired, actuating an automatic cut-out which stops the machine. The device is very easily installed, being inserted in a hole, drilled and tapped, in the bottom of the bearing housing as shown in fig. 1; where this plan is not feasible, it can equally well be fitted externally, being supported by a bracket under the shaft. The thickness of the insulating cap determines the minimum wear allowed before the alarm is given; any greater allowance can be made by screwing the stem up until the cap touches the shaft, and then withdrawing it to a distance indicated by a pointer over a scale graduated in mils. In any case where a stoppage would entail serious consequences, the device offers a simple safeguard.

The "Universal" Electric Toaster.

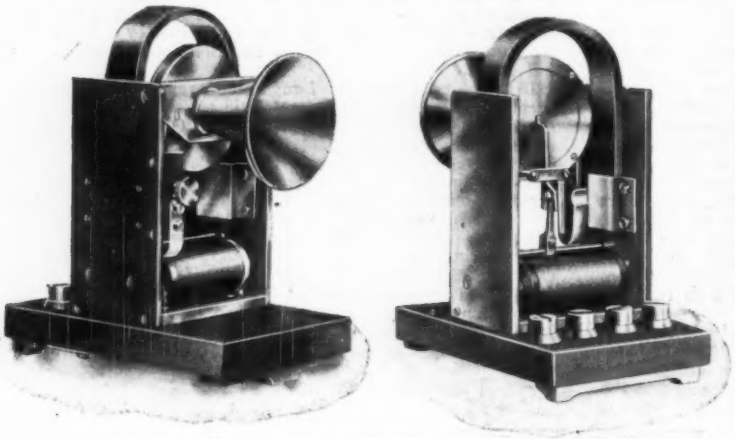
A new toaster, recently placed on the market by Messrs. L. G. Hawkins & Co., 116, Charing Cross Road, W.C.2, possesses the special feature of permitting the bread to be reversed without handling. This is accomplished by so hinging

Fig. 2.—The Universal Electric Toaster.

the two bread racks that they may be swung round to either side. The loading of the toaster is 340 W, it weighs 3 lb. with packing, and its height is 7 in. The appliance is nickel-plated.

A Direct Working Telegraph Sounder.

The moving part of an ordinary telegraph sounder consists of a lever which carries an iron armature and a milled head adjusting screw, the whole being of considerable weight, and owing to the lever being pivoted near one end, and the armature and milled head screw being fixed at some distance from the pivot, the moment of inertia is very large. In the diaphragm sounder (figs. 3 and 4), made by the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., the fixed part consists of two electromagnets placed side by side, whilst the movable part is constituted of two soft-iron armatures attached to a spindle pivoted at both ends and carrying in addition a projecting arm. The armatures are polarised by a fixed permanent magnet and play between the poles of the electromagnets, the whole arrangement being, therefore, both mechanically and magnetically, very similar to the well-known Post Office standard relay, the projecting arm corresponding to the tongue of the relay. This arm carries a steel head and constitutes a hammer which plays between the two limbs of a fork, striking first one and then the other under the influence of the line currents in the electromagnets.



Figs. 3 and 4.—A Direct-working Telegraph Sounder.

The fork forms the lower end of a light lever which is pivoted on a knife edge near its centre, the upper end of the lever being attached to the centre of a metallic diaphragm tightly clamped by its edges in a sound box. The blows of the hammer on the fork are thus transmitted to the diaphragm and this produces the sounds. The moving part of the new sounder has only about one-eighth the weight of the corresponding part of the ordinary sounder, and due to this, and to a better disposition of the moving parts around the pivot, the moment of inertia is less than one-fiftieth. In the sounder, as usually supplied, the adjustment is such that the 500+500 ohm instrument will work well at full key speed with about 3 milliamperes and upwards; or, when neutrally adjusted, it will work double current with from 1 to 30 milliamperes and upwards without alteration. Direct working without relays is, therefore, possible over long lines with comparatively small battery power. It also acts well with short discharges and is consequently suitable for working with condensers or induction coils.

An Electric Glossing Iron.

Attempts to produce a glossing iron for finishing off boots and other leather goods have usually resulted in an appliance much too heavy for use for any length of time. A glossing iron (fig. 5) recently put on the market by Electric Fires,

Fig. 5.—An Electric Glossing Iron.

Ltd., King Street, Norwich, weighs only 1 lb. The sole plate it suitably curved, and has a bright polish so that there is no possibility of scratching the leather. A heat-insulating device is inserted between the sole and the handle, keeping the latter cool. The iron has a 40-W element.

Norwegian Electro-Chemical Industry.—The workmen in this industry have rejected the terms of a proposed new wages agreement, under which a slight reduction would have been made.

ELECTRICAL NOTES FROM INDIA.

(By Our Special Correspondent.)

The Prince's Visit.—H.R.H. the Prince of Wales arrived in Bombay Harbour this morning (November 17th) on board H.M.S. *Renown*, and the city is *en fete* in consequence. The streets forming the processional route have been gaily decorated, and most of the larger buildings and Government offices, &c., have been illuminated externally.

The contours of towers, minarets, domes and cupolas have been strung with small power lamps, the total temporary lighting reaching the respectable figure of about 2,000 kW.

Extraordinary precautions have been taken to safeguard the continuity of supply, because fears have arisen that the followers of the notorious Gandhi might make some attempt to shut down the Kussara power station of the Bombay Electric Supply and Tramways Co., upon which the whole of Bombay's lighting depends.

Gandhi and his ill-advised followers have made an abortive attempt to boycott the Prince's visit, and shortly after the procession had passed to Government House this morning some rioting took place, and an effort was made to burn four or five tramcars. The troops fired on the rioters, and shortly afterwards tramway service was almost completely suspended.

Although the charge engineers at Kussara power station are Europeans, with one exception, all the operating staff are either Eurasian, Goan, or native; and it is difficult to say who may, or may not, be a Gandhi-ite, although these misguided individuals generally wear a distinctive cap. But consider the gorgeous simplicity of stopping a circulating pump or tripping a generating switch, or some other equally simple operation, and the anxiety of the supply authorities is easily understood.

A detachment of Royal Artillery has been posted at the power station, together with some armed police, and the Naval authorities have arranged to send stokers to operate the boiler house should necessity arise.

Two rehearsals of the illuminations took place at midnight on the 14th and 15th, and all passed off fairly satisfactorily.

There is no more loyal body of men than European electrical engineers in Bombay; but owing to the machinations of Gandhi, who wields a most extraordinary power over the uneducated coolie class in India, the supply engineers will heave a sigh of relief when the Prince leaves, on the 22nd inst. A "shut down" while H.R.H. is here would just about put the tin lid on everything, and cause the non-co-operators to howl with glee.

Later on a motor-car belonging to a tramway official was burnt, and many cars were damaged by stones, and the windows broken, &c.

Three native policemen were hammered to death and some eight or ten rioters were killed.

Writing on the following day, our correspondent stated that the full car service was again in operation, and peace apparently reigned once more.

Bombay, November 25th, 1921.

The unfortunate happenings among the lower class followers of Mr. Gandhi, the political leader, which terminated in bloodshed, and open faction fights between Mohammedans and Hindus, on one side, and Parsees, Eurasians, Anglo-Indians and Europeans on the other, somewhat marred the visit of the Prince of Wales, but they did not in any way interfere with the brilliant display of electric lighting, temporarily installed, on the exteriors of buildings. The connections made totalled something like 2,000 kW, and this extra load was met by the Bombay Electric Supply and Tramways Co., without a hitch of any sort. The *Times of India* describes the illuminations of the public buildings as a wonderful sight, whether viewed from the Bandstand, Wellington Fountain, Malabar Hill, or the broad open space in front of Victoria Terminus. It says that with the help of extensive illuminations on many business premises the general effect was such as has hardly been equalled in the history of the world.

The Government of Bengal has under consideration the question of adopting measures for proceeding with the hydro-electric survey of Bengal, in order to investigate and determine suitable sites for generating electric power. The question was discussed at the Conference of Members and Directors of Industries at Simla, and it was pointed out by the Chief Engineer, Hydro-electric Survey of India, that the responsibility for the survey rests with the Public Works Department, and that the Department of Industries is very closely connected with the question, as the possibilities of development of new industries, especially those for which electric power in large quantities is essential, depend greatly on the existence of cheap electric power.

To meet this interest, the Industrial Commission suggested the appointment of a joint committee, comprised of members

of the Public Works Department and the Department of Industries, to consider what measures should be taken to conduct and control the work of the hydro-electric survey in Bengal.

The Director of Industries suggested that the survey should be confined to the Hill Tippera area, round Commilla and Chattagong in the first instance.

The Government of Bengal has, after consideration, accepted the suggestion of the Industrial Commission; and the Governor in Council has been pleased to appoint a joint committee, consisting of the following members, to consider and submit a report on the matter:—

President: The Chief Engineer, Irrigation Department, Government of Bengal. Members: The Director of Industries, Bengal; the Electrical Adviser to the Government of India (Mr. J. W. Meares, M.I.E.E.), and the Electrical Inspector. Secretary: Under-Secretary to the Government of Bengal, Irrigation Department.

REVIEWS.

Electric Welding. By ETHAN VIALL. Pp. xii+417; 329 figs. London: McGraw Hill Book Co., Inc. Price 22s. net.

Mr. Viall is the editor of the *American Machinist*, and the author of a number of books on special engineering subjects. This volume shows the competent practical hand with access to ample sources of information which one naturally expects from such authorship.

It deals with electric welding processes generally, giving a sufficient and concise historical sketch of the origin and development of the processes, including some which have found no practical application, but are of interest as steps. Full credit is given to the pioneers of arc welding, all Europeans, and whilst to Elihu Thomson is quite rightly ascribed the invention of resistance welding, the interesting fact is recorded that Benardos patented spot welding in 1888, the essential difference between his apparatus and that in present-day use being that he used carbon electrode points instead of the copper electrodes which have made the process a practical one.

Much of the book is occupied with descriptions of equipments, tools, and appliances of American manufacture, doubtless based on information furnished by the makers, but inspired by a critical discrimination which makes them useful as guides for those who have to supply themselves in the United States. They have less interest for European purchasers. Some very useful hints about such auxiliary apparatus as electrode holders, shades, and so forth can, however, be gleaned from some of the descriptions.

With respect to arc welding, the carbon arc gets less than its due for some kinds of work; the covered metallic electrode shares a similar fate; and continuous current is advocated for metallic arc welding in preference to alternating. These features reflect American practice in arc welding, though from the number of alternating current equipments described many designers must have been at work, and there must be a considerable use of alternating current. The impression given is that on this side of the Atlantic there have been greater developments in the use of the carbon arc, the covered electrode, and alternating current arc welding, than on the other side.

There are two useful chapters on the training of arc welders and arc welding procedure, suggesting training exercises, and illustrated with some really informative figures. Suggestions for the design of welded joints are illustrated by many examples showing how the stresses in the work will be best resisted. This is a matter of great importance. It is the key to the successful extension of arc welding to structural work, of which only the beginning has yet been seen. It cannot be neglected with impunity in repair work, where it is more dependent on the mechanical sense and ingenuity of the operator than of a man at the drawing board. The author quite rightly insists on the necessity of training these qualities in would-be welders.

The illustrations in these chapters and that dealing with examples of actual work are of high educational value.

Chapters on the physical properties and metallography of "arc fused steel" so far as they are statements of fact, contain a large amount of information profusely illustrated. Some of the conclusions set out have a greater tone of finality than is warranted at present. It will not be accepted by all investigators that the metal of any arc weld is "essentially a casting." At least, it can be objected that the physical and metallographic characteristics of many welds are radically different from those of castings of the same composition. These characteristics are also susceptible of a greater amount of control than the author is disposed to admit. Nor will it be agreed on all hands that these "castings" are generally (or universally, as the author almost suggests) unsound from the presence of flaws of various kinds. Again, it is laid down that weld metal always, or nearly always, shows a considerable inclusion of nitride needles, and a notable quantity of nitrogen, with its well-known detrimental effects on the properties of the metal. It is stated that flux coating of the electrodes produces no material improvement in these characteristics of weld metal. This will certainly not be accepted on this side of the Atlantic. It may be suggested that these unacceptable statements are closely connected with the comparative neglect in the United States of work on electrode and flux composition with reference to the stock metal and the qualities of the weld.

Automatic arc welding is a branch of the art in which the Americans have it all their own way at present. The chapter describing some machines and work done by them, therefore, has the interest of novelty, though a few have been imported hither for exhibition. There are possibilities in this direction, appealing principally to the manufacturers of certain articles. Generally these machines may be described as machine tools by which metal is deposited on the work from an electrode instead of being cut off the work by a cutting tool. For welding joints or building up on cylindrical and circular articles, they should be very useful. If required, it seems easy to design automatic welders of other forms, *i.e.*, the analogues of planing machines, &c., as those described may be called the analogues of lathes. It is found possible to regulate the arc length and voltage to lower and more steady values than can be secured in hand welding, a circumstance favourable to sound welds and small waste of electrode. Whilst the chief field for these machines seems to be in repetition manufacture, it is possible that they will be found economical for building up worn shafts, tires, and so forth, where the quantities dealt with are considerable. If they can be adapted to use covered electrodes their value for such purposes will be greater.

The chapters dealing with resistance welding are almost entirely descriptive of the machines of various American makers. Most of these are special purpose machines, which is, of course, true of resistance welders in general. The illustrations of these machines are very good indeed.

There is good information about the energy consumption and the time element involved in welding various sections, the actual speed of operation, and on the strength of resistance welds.

It is hardly necessary to say that a book published by the McGraw Hill Co. is well printed, on good paper, comfortable to read and handle. It can be recommended as a book of reference, and those to whom it appeals will likely have their own views on matters controversial.—H. M. S.

Electricity in Steel Works. By W. MCFARLANE, B.Sc. London. Pp. x+109; 21 figs. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

High-tension Switchboards. By H. E. POOLE, B.Sc., A.C.G.I., A.M.I.E.E. Pp. ix+114; 22 figs. London: Sir Isaac Pitman & Sons, Ltd. Price 2s. 6d. net.

The first of these publications, both of which are included in Pitman's Series of Technical Primers, is of the nature of a review of current electrical practice in steel works, and fulfils quite a useful function owing to the rapid progress that has been made in the electrification of such works during the last decade. The first chapter deals in a very interesting manner with the general question of electricity supply in steel works, particular attention being paid to the question of the proper utilisation of the surplus heat generated in certain processes, and is followed by others dealing in some detail with main and auxiliary motors and their control. Lifting magnets and lighting problems are also discussed.

Little fault can be found with the book apart from one or two instances of rather vague wording in connection with explanations of electrical working, which have doubtless been caused by the necessity of economising space. We notice that the possibilities of the eddy-current controller for three-phase slip-ring induction motors are mentioned, and it would have been interesting if some definite information had been given concerning the starting torque obtainable with this arrangement.

The work will be very useful to students and others desiring to obtain an insight into the possibilities of the applications of electricity for the purpose under notice.

The second book, which may be looked upon as a companion and supplementary volume to that on high-pressure switchgear in the same series and by the same author, is mainly occupied with an account of the general arrangements of types of boards suitable for central stations, factory, and mining purposes. The mechanical arrangements of boards are well, though briefly, described, but lack of space has prevented a full discussion of some technical points of interest at the present time. Thus we find that arrester gear is dealt with in a very brief manner, and the uses of reactance coils are discussed in a few lines.

One or two details call for modification when a further edition appears; thus we find the Board of Trade referred to (for example, in connection with a reference to mining gear) when the Home Office would be more appropriate, and an instrument for the measurement of energy, while usually referred to as an integrating wattmeter, is, in one place, termed an integrating watt-hour meter.

A short chapter at the end deals with common conventions used in connection arrangements for switchboards, and in making switchboard diagrams; these seem to be founded on the recommendations of the B.E.A.M.A., but the fact is not mentioned.

The book should be useful to those desiring to obtain a general idea of the types of high-pressure boards commonly used at the present time.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEXTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

31,369. "Valve cap sparking plugs." A. Chambers. November 23rd.
31,376. "Holders with locking devices for incandescent electric lamps." F. W. Coombe and J. J. Webber. November 23rd.
31,387. "Means for coupling alternating-current generators in parallel." N. E. G. Meijer. November 23rd.
31,394. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). November 23rd.
31,395. "Electro-static telephones." J. Engl, J. Massole, and H. Vogt. November 23rd.
31,407. "Electric accumulators." A. Neumann and O. Neumann. November 23rd. (Germany, August 17th.)
31,432. "Motor for utilising electromagnetic energy of the earth." W. E. Hitch. November 24th.
31,437. "Electrically-driven gear for conversion of hand-operated knitting machines to power-driven." J. H. Borland. November 24th.
31,461. "Steam wagon electric lighting set." H. C. H. Bull. November 24th.
31,490. "Selecting devices for automatic, &c., telephone systems and circuits therefor." H. E. Humphries and Siemens Bros. & Co., Ltd. November 24th.
31,502. "Electric alternators." F. Contell. November 24th.
31,509. "Method of applying magnetic material to electrical conductors." Western Electric Co., Ltd. November 24th. (United States, December 8th, 1920.)
31,510. "Electromagnetic relay." Western Electric Co., Ltd. (Western Electric Co., Inc.). November 24th.
31,511. "Signalling systems." Western Electric Co., Ltd. (Western Electric Co. Inc.). November 24th.
31,517. "Electric lamps." K. Krausser. November 24th. (Germany, December 20th, 1920.)
31,536. "High-frequency telephony." Ges. fur Drahtlose Telegraphie. November 24th. (Germany, February 5th.)
31,537. "Wireless direction-finding apparatus." Ges. fur Drahtlose Telegraphie. November 24th. (Germany, December 14th, 1920.)
31,538. "Thermionic generators." Ges. fur Drahtlose Telegraphie. November 24th. (Germany, January 11th.)
31,539. "Circuits for electrical oscillations." Ges. fur Drahtlose Telegraphie. November 24th. (Germany, November 25th, 1920.)
31,544. "Electric arc welding." A. E. McCarthy, H. Martin, and L. J. Steele. November 24th.
31,545. "Electric telegraphs." A. L. Davis. November 24th.
31,568. "Ignition apparatus." R. Bosch Akt. Ges. November 25th. (Germany, November 25th, 1920.)
31,572. "Electric wall plugs, &c." W. H. Tant. November 25th.
31,595. "Electric switches." G. H. Ide and F. Painter. November 25th.
31,597. "Electric switches." W. Sparks and W. H. Tonks. November 25th.
31,604. "Electric switch locator." W. Helmore. November 25th.
31,607. "Thief-proof combination switch for motor-cars." T. H. B. Gayner. November 25th.
31,622. "Process for producing electrically-insulating and mechanically-adherent coating on metal articles." F. Krupp Akt. Ges. November 25th. (Germany, December 13th, 1920.)
31,630. "Apparatus for reproduction of sound waves." R. Mylo. November 25th. (Germany, December 2nd, 1920.)
31,642. "Electric fuses." W. M. Harrington, W. E. Bottom, and M. H. Goldbarb. November 25th.
31,646. "Battery case carrier for road vehicles." A. H. Hunt. November 25th.
31,658. "Switching devices for overhead runways." W. S. Douglas. November 25th.
31,664. "Anti-vibration device for electric lamps." S. C. Simpson. November 26th.
31,665. "Telemotor apparatus." T. C. Fortescue and W. J. Paulin. November 26th.
31,730. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). November 26th.
31,754. "Electric fuses or cut-outs." V. Hope. November 28th.
31,755. "Ironclad electric switches." V. Hope. November 28th.
31,756. "Ironclad electric switches." V. Hope. November 28th.
31,772. "Electric switch boxes, distribution boxes, &c." L. J. Lepine. November 28th.
31,793. "Wooden poles for carrying overhead electric wires." Crompton and Co., Ltd., and J. N. A. Houblon. November 28th.
31,816. "Telegraphy." T. B. Dixon. November 28th.
31,824. "Telephone sub-station metering and/or tolling." E. Noble. November 28th.
31,833. "Jet condensers." Metropolitan-Vickers Electrical Co., Ltd. November 28th. (United States, December 3rd, 1920.)
31,834. "Electrical measuring-instruments." Metropolitan-Vickers Electrical Co., Ltd. November 28th. (United States, December 7th, 1920.)
31,839. "Electric welding of cast iron." Soudure Autogene Francaise. November 28th. (France, December 24th, 1920.)
31,843. "Windings for armatures of dynamo-electric machines, &c." W. B. Sayers. November 28th.
31,851. "Ignition devices for explosion engines." S. Maroger. November 28th. (France, July 1st.)
31,873. "Power integrating and limiting systems." Forges et Ateliers de Constructions Electriques de Jeumont. November 29th. (France, December 3rd, 1920.)
31,874. "Switches." R. Bosch Akt.-Ges. November 29th. (Germany, November 29th, 1920.)
31,878. "Sparking-plugs, &c." J. A. Horton. November 29th.
31,879. "Electric lighting systems." R. A. Macaulay. November 29th.
31,884. "Electric pipe, cigar, &c., lighter." R. M. Linfoot. November 29th.
31,892. "Brake mechanism for tramway, &c., vehicles." C. H. Spencer. November 29th.
31,900. "Electric fuses." J. H. Williams. November 29th.
31,927. "Galvanic batteries." Fuller's United Electric Works, Ltd., and A. P. Welch. November 29th.
31,936. "Overload switches for protection of motors." F. Krupp Akt.-Ges. November 29th. (Germany, December 30th, 1920.)
31,938. "Electric motor for gramophones, &c." W. White. November 29th.
31,948. "Radio receiving systems, &c." L. E. Owen. November 29th.
31,950. "Multi-wire safety fuse." K. V. L. Jensen and Jensen Trading Co., Ltd. November 29th.
31,960. "Mercury, &c., vapour electric lamps." F. A. King, F. Reynolds, and Silica Syndicate, Ltd. November 29th.
31,976. "Electric-motor controllers." British Thomson-Houston Co., Ltd. November 29th.
31,982. "Cooling electrical apparatus." F. A. Yerbury. November 29th.
31,997. "Means for electro-magnetically locking, &c., railway, &c., carriage doors." P. W. Duckenfield, H. Frolich, A. T. W. Jubb, and G. Ross. November 29th.
32,019. "Reducing capacity current losses in electric cables." A. M. Taylor. November 30th.
32,027. "X-ray centring-device." A. J. Walton. November 30th.
32,058. "Apparatus for electro-therapeutic use." W. G. Moore. November 30th.
32,066. "High-frequency transformers." W. Dornig. November 30th.
32,067. "High-frequency transformers." W. Dornig. November 30th.
32,068. "Electric condensers." W. Dornig. November 30th.
32,094. "Electric irons, ovens, hot-plates, &c." J. J. J. M. Kluijtmans and Phi-Kappa Syndicate, Ltd. November 30th.
32,101. "Electric power-transmission mechanism." W. L. Baynham. November 30th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1920.

13,240. "Process and apparatus for coating articles by electro-plating and heat treatment." A. Marek. October 10th, 1917. (143,250.)
13,645. "Selecting devices for automatic telephone systems." Siemens Bros. & Co., Ltd., E. A. Petithory, and J. E. Collyer. May 18th, 1920. (171,423.)
15,338. "Collectors for magnetos used with four-cylinder internal-combustion engines." G. B. Gousset. June 20th, 1919. (145,406.)
18,567. "Dynamo-electric machines." E. Greenhalgh and Electromotors, Ltd. July 5th, 1920. (171,439.)
18,608. "Electric lamps." A. Zoller and G. Fischer. November 7th, 1913. (146,492.)
19,344. "Electronic tubes." Ges. fur Drahtlose Telegraphie. January 23rd, 1918. (147,441.)
19,377. "Electric discharge tubes for coupling electric circuits." F. Schroter. February 9th, 1915. (147,463.)
19,390. "Electro-magnetic wave-receiving systems." Soc. Francaise Radio Electrique. May 7th, 1919. (147,466.)
19,395. "Process for operating internal-combustion engines with difficulty volatilisable fuel and electric ignition." F. L. Madler. May 20th, 1919. (Patent of addition not granted.) (147,475.)
19,805. "Construction of armatures for dynamo-electric machines." V. G. Apple. January 29th, 1917. (147,777.)
19,806. "Armature construction for dynamo-electric machines." V. G. Apple. November 19th, 1914 (147,778.)
20,288. "Electric generating systems." Kohler Co. March 20th, 1919. (148,368.)
20,845. "Acoustical improvements in electro-magnetic sound producers and receivers." Signal Ges. January 20th, 1919. (Addition to 148,976.) (148,985.)
20,879. "Railway and the like signalling systems." J. Bethenod. July 12th, 1920. (Convention date not granted.) (Addition to 148,990.) (155,800.)
20,916. "Automatic and semi-automatic telephone systems." Siemens Bros & Co., Ltd., and D. A. Christian. July 12th, 1920. (171,433.)
20,931. "Method for generating and amplifying oscillations of any frequency especially for wireless telegraphy." Dr. E. F. Huth Ges. and W. Heller. July 17th, 1918. (149,192.)
20,933. "Arrangement for wireless telegraphy from submarines." Dr. E. F. Huth Ges. and B. Rosenbaum. December 8th, 1916. (149,194.)
20,953. "Process for photographically recording sound-waves." R. Mylo. November 10th, 1915. (149,206.)
21,047. "Electro-magnet for locking devices." Luftfahrzeugbau Schutte-Lanz. December 9th, 1916. (154,914.)
21,056. "Driving system for alternating-current meters on the Ferraris principle." L. Adert (formerly A. Adamczak). December 31st, 1918. (151,245.)
21,067. "Safety switch for installation systems and for winding of electrical machines and apparatus." Allgemeine Elektricitats-Ges. November 6th, 1913. (152,316.)
21,077. "Coin-freed meter for electric current, gas, water, or the like." Allgemeine Elektricitats-Ges. September 19th, 1914. (151,972.)
21,078. "Coin-freed meter for electric current, gas, water, or the like." Allgemeine Elektricitats-Ges. July 4th, 1917. (151,973.)
21,256. "Radio-signalling systems." L. De Forest. May 10th, 1915. (149,272.)
21,381. "Driving electro-mechanism for operating rail-track apparatus." T. Ducousso. July 15th, 1920. (171,441.)
21,490. "Apparatus for electric arc welding." British Thomson-Houston Co., Ltd. (General Electric Co.). July 16th, 1920. (171,442.)
23,329. "Electrical resistances." W. Clark and Clark's Neo-Electric Devices, Ltd. August 9th, 1920. (171,451.)
23,391. "Modulation systems and the like in radio-communication and the like." J. Scott-Taggart and Radio Communication Co., Ltd. August 10th, 1920. (171,453.)
23,479. "Electric arc lamps." A. H. Railing and A. E. Angold. August 11th, 1920. (171,458.)
23,606. "Safety-lock electric switches." F. P. Smith and T. F. Wilson. August 12th, 1920. (171,463.)
23,727. "Method and means for determining the transmission equivalent of an electrical circuit." Western Electric Co., Ltd. (Western Electric Co., Inc.). August 13th, 1920. (171,470.)
23,859. "Devices for regulating the amplitudes and damping in sound apparatus." Signal Ges. August 16th, 1920. (150,265.)
23,863. "Variable electrical condensers." H. W. Sullivan and J. Joseph. August 16th, 1920. (171,481.)
23,965. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). August 17th, 1920. (171,484.)
24,198. "Three-phase electric furnaces." D. Mauri. August 19th, 1920. (171,494.)
24,328. "Switch and fuse-holder units for use in electric car-lighting systems." C. A. Miller, F. J. Miller, and E. A. Saunders. August 21st, 1920. (171,497.)
24,329. "Circuit arrangements for controlling automatic selector switches." Automatic Telephone Manufacturing Co., Ltd., and R. Mercer. August 21st, 1920. (171,498.)
24,456. "Electrolytic apparatus." G. O. Seward. August 23rd, 1920. (171,502.)
25,378. "Production of and modulation of electrical oscillations by means of thermionic valves." Radio Communication Co., Ltd., and N. Lea. September 2nd, 1920. (171,520.)
25,487. "Number-dials for automatic and semi-automatic telephone systems." Siemens Bros. & Co., Ltd., E. A. Petithory, and J. E. Collyer. September 3rd, 1920. (171,523.)
25,833. "Electric cooking appliances." A. C. Hammonds and M. J. Wagg. September 8th, 1920. (171,544.)
25,959. "Sparking-plugs for internal-combustion engines." S. Remus. September 9th, 1920. (171,547.)
26,113. "Electric ignition in internal-combustion engines." F. H. Richards. September 10th, 1920. (171,553.)
26,117. "Electric power transmission." A. M. Taylor. September 11th, 1920. (Patent of addition not granted.) (171,554.)
27,477. "Electro-magnetic relays." Automatic Telephone Manufacturing Co., Ltd. December 31st, 1919. (156,076.)
28,214. "Electric switches." J. Watkinson. October 5th, 1920. (171,578.)
28,278. "Electric switches." J. A. Crabtree. October 6th, 1920. (Addition to 140,180.) (171,579.)
28,386. "Electric switches." F. Painter and G. H. Ide. October 7th, 1920. (171,581.)
34,522. "Electric pocket lamps." O. Hoffmann. November 4th, 1913. (154,931.)

1921.

27,329. "Sparking plugs for internal combustion engines." Sphinx Manufacturing Co., Ltd., and W. A. Clark. September 25th, 1920. (171,271.)
6,021. "Thermionic valves." M. Latour. March 18th, 1920. (160,456.)